ELECTRICAL REVIEW

THE PIONEER ELECTRICAL WEEKLY OF AMERICA

VOL. XLIII. No. 22. NEW YORK, SATURDAY, NOVEMBER 28, 1903. ISSUED WEEKLY.

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WESTERN OFFICE: 40 Dearborn Street, Chicago, Ill. . . . CHARLES FFRENCH, Manager
EUROPEAN OFFICE: 42 Old Broad Street, London, E. C. . . . HENRY W. HALL, Manager

TELEPHONE "21 Cortlandt." Private exchange to all Departments.
REGISTERED CABLE ADDRESS: "Electview," New York.

SUBSCRIPTIONS

One Year, United States and Canada $3.00
One Year, Foreign Countries 5.00
Single Copies, each 10
Copies supplied for only one year back, each 25

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NEW ADVERTISEMENTS should be in the office not later than *Monday noon* to assure publication in that week's issue.

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The London correspondent of the New York *Sun*, whose prediction we published last week, hopes to telephone from his London office to headquarters in New York within a year. It is too bad that our enterprising daily journalist is compelled to "wait the permission of the inventors before making more than this general announcement." We hardly believe that a Pupin cable could be manufactured and laid in twelve months, therefore we must eliminate that. And if it is the long distance wireless telephone, we hope the permission of the inventor will be granted without delay as we are all deeply interested. There is one disadvantage to progress in this direction; that is the difference in time will cause our English cousins to disturb our slumbers, and *vice versa*. We again urge you, Mr. *Sun* correspondent, to prevail upon the distinguished yet retiring inventors to hasten and let us know details.

THE VINDICATION OF THE STORAGE BATTERY.

It was only a few years ago that the storage battery was in disfavor. Storage battery cars had not been successful, and the apparatus itself was looked upon with much distrust. It was not, however, without its advocates for other uses, and in one notable instance a storage battery was installed on an important electric railway system by a prominent engineer, though this was done entirely at his own risk. In those days, unfortunately, engineers, as a rule, knew very little about the behavior and capabilities of the storage battery. It was thought of merely as a device for supplying electrical energy during the times when the generating station was shut down. How completely opinions have changed since then, was shown at the recent meeting of the American Institute of Electrical Engineers. Here an excellent paper by Mr. Lamar Lyndon discussed the capabilities of the storage battery as an auxiliary to the generating plant, and in the discussion which followed, all who took part expressed the opinion that this apparatus has become to-day an absolutely essential part of every large electrical system. The battery not only reduces load fluctuations on the station and assists in maintaining a constant voltage, but it ensures the system against breakdowns. There is a number of very large stations which to-day could carry the entire load from a battery, although every engine was thrown out of service.

Computing for a Battery Installation.

Mr. Lyndon's paper took up one application only of the storage battery, showing how it could be used to reduce load fluctuations on a railway system and, at the same time, effect a saving in copper and in the size of the generators. The effect of placing a storage battery at the station or out on the line is shown by a very simple method, which reduces the labor of calculating to a minimum.

Storage Battery Essential in All Systems.

Such papers are extremely important, as they give to those engineers who have not had an opportunity to make a special study of the storage battery valuable information. The storage battery will find a general application in the future, not only in such direct-current systems as may survive, and in those alternating-current transmitting systems which distribute direct currents, but, as well, in the pure alternating-current systems themselves. Here it is of vital importance to prevent absolutely any interruption of the exciting system, for which purpose the storage battery serves. It seems, therefore, that it will be necessary for all electrical engineers, in whatever line of work they may be engaged, to know something about the storage battery and its applications. It has become essential to prevent interruption of the service and it is now the duty of the engineer to see that the battery itself does not break down.

RAISING THE VOLTAGE.

When the demand on a low-tension distributing system approaches its full capacity, to provide for the increase, the plan of raising the voltage is usually examined and often adopted. If a radical change, such as doubling the voltage, is decided upon, much of the old apparatus will have to be discarded or rewound; involving considerable expense. To avoid this a German engineer suggests raising the voltage gradually, say five volts a year until it has been increased from ten to twenty per cent. In this way all the old apparatus can be retained, the only change necessary being to add to the storage batteries a sufficient number of cells to bring them up to the proper voltage. Raising a 100-volt system to 120 volts increases its capacity about nineteen per cent, while if raised to 130 the increase is about forty per cent.

ILL-CONSIDERED REPORTS.

In describing the deplorable rear-end collision which happened November 19, on one of the Brooklyn elevated railroads and which resulted in the death of two train hands, the Metropolitan press, as a whole, treated the matter fairly. The details of the accident, so far as ascertainable, were given, the dangers involved in any transportation system where high power machinery is employed, were pointed out and such comments as were made were, in general, based upon reliable information and good sense.

Unfortunately, this sensible stand was not taken by all the New York papers, and one of them, which has not a reputation for sensational writing, took occasion to enlarge upon the dangers of electric traction. This paper referred to the "deadly third rail," as though that had been the cause of the accident, quoted an alleged "high authority," as saying that the third-rail system is dangerous, as "we still know very little about electricity," and finally expressed the opinion that the whole system would have to be changed on account of its dangers. The tone of the entire article was such as to add to the nervous feeling already existing in a large part of the riding public.

Now it is one thing to point out defects in a system and it is another to magnify its dangers and thus make the public unnecessarily nervous. It is this condition that the railway companies most dread, as it is likely, at any time, to cause a serious accident when there is no danger, and it makes matters far worse when there is real trouble. The conditions existing at our large cities make faster and larger trains necessary. Such trains are heavy and are equipped with motors of large power. Unfortunately, in spite of all precautions, accidents do happen to the trains, but the ratio of injuries to the total number of passengers carried is very small and the railroad companies are developing safeguards as rapidly as possible. The daily press is probably the most powerful educating agency in the world and there is here an excellent opportunity for it to do good by disabusing the public of the idea that electric traction is very dangerous. The sensible view taken by most of the New York papers of the recent accident is much to be commended.

THE HEATING EFFECT OF RADIUM.

When MM. Curie and Laborde announced their discovery of the fact that radium continuously emits heat at a rapid rate, two hypotheses were put forward to account for what at first appeared to be an exception to the law of the conservation of energy. According to this law, a body which gives off heat continuously must either receive energy from some external source, or its internal energy must decrease.

Effect Attributed to Unknown Form or Radiation.

The first condition is assumed in one of the theories offered, but as it has been shown that the action takes place when the radium does not receive energy in any of the forms in which we know it, it is necessary to assume, further, that the energy received by radium is some unknown form of radiation which is converted by it into heat and radiated as such. While there is no experimental basis to support this theory, it must be remembered that the phenomenon of a substance continually giving off energy, without apparent change, is new, and can only be explained by some heretofore unknown action. Far-fetched as this idea of an unknown radiation may seem, it is no more startling than the other explanation offered; but the latter has received more support, although if true it upsets a fundamental theory of chemistry.

Disintegration Theory.

This theory put forward by Rutherford and Soddy assumes that radium is an unstable element; that its atoms are slowly disintegrating, and that, during this disintegration, energy is set free in the form of heat. The reaction may be compared with the breaking up of an unstable chemical compound, though in the case of radium, the change is assumed to take place in the radium atom itself. This theory is supported by the fact that radium gives off a gaseous emanation, differing in properties from the original material.

An Important Experiment.

To throw some light on this important question, Professors E. Rutherford and H. T. Barnes have measured the heat radiation of radium emanation, and describe their work in a communication to *Nature,* for October 25. They measured, first, in a differential air calorimeter, the heat given off by thirty milligrammes of pure radium bromide. The bromide was then heated to drive off the emanation, and the latter was condensed in a glass tube which was sealed off. The heating effects of both the emanation and the deemanated radium were then measured separately. It was found that the heating effect of the deemanated radium diminished rapidly during the first few hours, and fell to a minimum, corresponding to about thirty per cent of the original value, and then slowly increased again; while, on the other hand, the heating effect of the emanation tube first increased for a few hours to a maximum, corresponding to about seventy per cent of the original heat emission of the radium, and then slowly decayed with time. At any time after removal of the emanation, the sum of the heating effect of the deemanated radium and of the emanation was found to be the same as the original radium.

Heat Radiation Varies with Radioactivity.

It has been shown that if the emanation is removed from radium, the activity of the radium as measured by the α rays decreases in the course of a few hours to twenty-five per cent of its original value, while the activity of the emanation immediately after separation measured in the same manner rises; and that, at any time after separation, the sum total of the activity of the radium and the emanation has a value equal to that of the original radium. It is thus shown that there is a parallel between the variation in radiating power, measured by the α rays, and the heating effect of radium. This fact seems to Messrs. Rutherford and Barnes to be strong evidence in support of the disintegration theory. As radium disintegrates and sets free its emanation, there is a liberation of heat. If the emanation is separated from the radium, it carries the greater part of this heat with it, and gradually gives it up to the containing-vessel. To explain the increase which takes place immediately after separation, it is thought that the disintegration of the radium atom takes place in stages. About twenty-five per cent of the heat of disintegration is set free in the first stage of breakdown during which the emanation is formed, and the remainder in the other stages which take place afterward. The behavior of the deemanated radium is supposed to show that immediately after separation it is giving off heat which it received during the formation of the emanation. The heat radiated will then gradually decrease as it is given up until the heat developed by further disintegration causes the radiation to increase. In each case kinetic energy is liberated by the expulsion of the small charged particles of the α rays, and where the energy of these is absorbed heat appears.

The Explanation Questioned.

This explanation is questioned to Mr. Arthur Schuster also in a communication to *Nature* as it does not seem to him to explain the increase in heat liberated by the emanation immediately after separation, and the corresponding decrease shown by the deemanated radium. He thinks that, since the emanation itself begins to form again from the radium immediately after separation, the heating effect of the deemanated radium should start with a minimum, and then gradually increase; and that the opposite result should be observed in the emanation after separation. He suggests that the heating effect may be due to excited activity. After separation of the emanation, the deemanated radium retains its excited activity for some hours. During the course of the first few hours there is very little emanation, but there is excited activity, which falls to a minimum, and then slowly grows again as the formation of new emanation once more excites it. Mr. Schuster thinks the same explanation will account for the increase in the heating effect of the emanation after separation, as the effect seems proportional to the amount of excited activity present, and not to the amount of emanation. If due simply to disintegration of the radium atom, one would not expect an increase in the heating effect after separation. Mr. Schuster, however, does not offer any explanation of the manner in which the excited radioactivity causes heating. What is one of the most noteworthy facts observed in connection with radioactivity is the comparatively large amount of heat liberated by a quantity of matter, so small in this case that it could not be seen nor weighed, but could only be detected by its radioactivity and heating effect. We have been accustomed to considering the energy changes involved in chemical reactions as large, but they seem to be insignificant when compared with the energy transformations involved in atomic changes.

ELECTROLYSIS IN BRIDGE STRUCTURES.

BY GEORGE T. HANCHETT.

Large bridges, particularly those of the suspension type involving a long length of continuous metallic conductor connecting two distant points in the earth, exercise no little influence in disturbing the conductivity of the ground return for neighboring trolley systems. As such bridges *per se* exist only where electric trolley systems are very numerous, and often traverse the structure itself, it is important to seriously consider whether or not currents will flow in this structure, and granting that they do, whether they will do damage. In complete existing structures it is very easy to determine not only whether current exists in such cables, but the magnitude and direction. This may be done by measuring the potential around a known section of the cable by means of a suitable instrument, and if the structure of the cable is known and the conductivity of the material of which it is made, the actual magnitude of the current flowing is only a matter of a few figures. These currents will often be surprisingly large because the resistance of the cable is so low that a fraction of a volt is amply sufficient to force a very formidable current through it. The question then arises, where does this current leave the cable and under what conditions? If it leaves the cable from a solid metallic contact, there is little or no danger of corrosion at the point of leaving, but if it leaves from an anchorage in moist surroundings, as it is likely to do, it is certain, sooner or later, to corrode the anchorage so badly as to make it unsafe. If the anchorage is always in a place where it can not be readily inspected, the case becomes one of speculation, and it is very difficult to say how much current is flowing through the anchorage or what damage it is doing.

Bearing in mind the fact that the electric pressure to be insulated against is only a volt or two, it does not seem an at all impossible matter to insert in such a cable line an insulating joint of ample strength, both mechanically and electrically, to withstand the load and keep the current out of the cables. Many insulators are enormously strong under compression, however unsatisfactory their transverse and tensile strengths may be, and though they be inferior to steel and iron in their ability to resist stresses, the problem simply resolves itself into a computation of a proper area of section. It may, of course, be argued that the direct effect of electrolysis from railway return currents on such structures as these is very slight, but granting that that be true, it must be remembered that bridges of this character are built for all times, and given a sufficient time, a slight electrolysis may produce serious results.

It will soon become a part of suspension bridge engineering to measure the difference of potential between the points to which it is proposed to connect the anchorages, and to ascertain the source of such potential, and whether or not the power behind it is sufficient to cause it to produce currents of any volume through the proposed structure.

Electrical Progress in the Nineteenth Century.

The Royal Philosophical Society of Glasgow, says the London *Electrical Engineer,* has arranged for the delivery of a special centenary series of lectures during the coming session in connection with the advancement of science during the existence of the society. The first of the series was delivered by Professor Andrew Gray at the opening meeting of the session on the fourth instant, and he chose for his subject "Electrical Progress in the Nineteenth Century." The lecturer traced the progress of electricity from the time of Galvani and Volta up to the present day, passing in review the work of leading scientists and physicists who had been chiefly responsible for this development. Thus, the achievements of Cavendish, Davy, Oersted, Nicolsin, Carlile, Ampere, and Faraday were individually described and commented on by the lecturer, who, in his reference to the electrochemical industry, deplored the fact that an electrical discovery made in this country had, through the apathy of our manufacturers, been allowed to become the foundation of what was mainly a German industry. In connection with Faraday's work, Professor Gray showed Lord Kelvin's reflecting galvanometer for the observation of induced currents, and made some experiments with it during the evening. Lord Kelvin's papers on the voltaic cell were mentioned, and a short account was given of his theory of the oscillatory discharge of a condenser, and the bearing of this result on the present-day experiments in electric wave telegraphy. Professor Gray next sketched the work of Gauss and Weber and the British Association Committee on Electrical Units and Standards, and gave a short history of the earlier researches on the determination of the ohm carried out by Thomson, Maxwell, and more lately by Lord Rayleigh. The lecturer also referred to Dr. John Hopkinson in connection with improvements in electric generators and motors, and went on to give a short exposition of Clerk Maxwell's great generalization—the electromagnetic theory of light—and of its direct verification by the experiments of Hertz. He concluded with references to the experiments in Hertzian wave telegraphy, and to the astonishing results that have followed the discovery of radioactivity. As to the progress made in the next century, he said it would be based on the knowledge gained in the past 100 years, and those who by spending laborious days and nights had built it up would be held in imperishable renown.

Programme of the Annual Convention of the Interstate Independent Telephone Association.

The annual convention of the Interstate Independent Telephone Association will be held at the Auditorium, Chicago, Ill., December 8, 9 and 10, 1903. An elaborate programme has been prepared, both from a technical and social point of view. Any corporation, copartnership or individual interested financially in or operating an independent telephone exchange or toll line, or any corporation, firm or person engaged in manufacturing any kind of independent telephone apparatus or equipment, or any supply house, is entitled to membership, and all are urged to attend the approaching convention, whether members or not. The association embraces over 8,000 independent exchanges and all of the factories and supply houses in the United States. A banquet will be given, and Cregier's orchestra of forty men has arranged a complete concert programme for the pleasure of the delegates. Reduced rates on all railroads have been arranged for.

A special programme has been announced which will be as follows:

Tuesday Morning, December 8—Reception of members and friends by the executive committee and officers, at the secretary's headquarters.

Tuesday Afternoon—Address of welcome, by the Hon. Carter H. Harrison, Mayor of Chicago; response and annual address by the president, Senator C. E. Hull, Salem, Ill.; report of the secretary and report of the treasurer will be read; selection of executive board; selection of nominating committee, and revision of constitution and by-laws.

Wednesday Morning, December 9—The officers and executive board will take charge of the delegates. Visiting exhibits.

Wednesday Afternoon—Wednesday afternoon will be devoted to addresses as follows: "Should the Territory of the Interstate Independent Telephone Association Be Enlarged, and if so, Why?" by the Hon. John Van Nortwick, Appleton, Wis.; "Are Our Telephone Periodicals Sufficiently Careful as to the Business Relations Sustained by Contributors?" by W. H. McDonough, New York, N. Y.; "Standardization of Apparatus," by Professor J. C. Kelsey, Purdue University; "Standardization of Construction," by W. C. Polk, Kansas City, Mo.; "Competition Between Independent Companies and Farmers' Mutuals," by O. Rex, North Manchester, Ind.

Thursday Morning, December 10—"Independent Toll Line Systems, and Is the Time Ripe for Merging," by J. S. Bailey, Jr., Toledo, Ohio; "Where Should the Line Be Drawn Between Independent Operating and Manufacturing Companies, and the Bell Company," by the Hon. Henry A. Barnhart, Rochester, Ind.; "What Should Be the Representation in Connection of the Interstate Independent Telephone Association in Voting?" by David Prewitt, Winchester, Ky.; "Who Is Who? What Are the True Ear Marks?" by the Hon. Theodore Gary, Macon, Mo.

Thursday Afternoon—Officers and executive board will take charge of and entertain the attending delegates. Visiting exhibits.

General Electric Company in International Agreement.

Announcement has been made that the General Electric Company has completed a working agreement with the Deutsche Allgemeine Electrische Gesellschaft, of Germany. The German company includes, or has agreements with, practically every large electrical concern in continental Europe. It is said that the Westinghouse company is also comprehended in the combination, and trade agreements will be made which will include all of the operations of these two American companies and the European combination.

The New York Central & Hudson River Railroad Company has placed an order with the General Electric Company for eight turbo-generators, of a capacity of 7,500 horse-power each. The turbines are of the four-stage vertical Curtis type. The generators are twenty-five-cycle, three-phase, generating current at a pressure of 11,000 volts. This is by far the largest order for steam turbines ever placed in this country or abroad.

The New York Central company has also placed with the General Electric Company an order for thirty electric locomotives. These locomotives are of an entirely new design, will weigh eighty-five tons each, with an adhesive weight on the drivers of sixty-seven tons. Each locomotive will have a capacity of 2,200 horse-power and will be capable of hauling a train of 500 tons at a speed of sixty miles an hour. This is by far the largest order for electric locomotives ever placed in any country.

The New York Central installation will ultimately include not only the equipment with electricity of the terminals, but probably also about fifty miles of railroad on each one of the New York Central branches, as well as the New York, New Haven & Hartford suburban lines.

Latest Developments on Berlin-Zossen High-Speed Railway.

By Frank C. Perkins.

THE extremely high speeds attained recently on the Marienfelde-Zossen polyphase railway have renewed the interest in this experimental line, which has demonstrated in the past three years the feasibility of operating electric lines with high-tension alternating currents reaching at least 14,000 to 15,000 volts. The accompanying illustration, Fig. 1, shows the new track construction as well as the three overhead wires required for supplying the three-phase current to the high-speed locomotive and motor car. The latest report up to date from the Siemens-Schuckert Werke, of Berlin, Germany, states that on October 23 a speed of 207 kilometres per hour was attained with perfectly smooth running and under very satisfactory conditions, the voltage being that above mentioned.

The Marienfelde-Zossen section includes twenty-three kilometres, or about fourteen miles of track with grades up to three per cent and curves of 2,000 metres radius, the lines being straight nearly the whole distance. The rails of the original track weighed thirty-two kilogrammes per metre, and when the speed trials were under way it was found that at speeds exceeding 160 kilometres per hour the rails showed signs of bending and the sleepers, which were of iron, were cracked in places. This track construction was therefore considered unsafe for very high speeds and application was made to the Koeniglich Preussichen Eisenbahnministers for a heavier and new track and more solidly constructed roadbed. The trial track was therefore completely renewed and the gravel bed was replaced by a bed of finely pounded gravel. The broken basalt employed as a ballast has produced a very fine foundation and the new track construction is similar to the heavy permanent way used with the Preussichen high-speed trains in connection with special safety devices employed to guard against derailments.

On about seventeen kilometres length of track of the total twenty-three kilometres a guide rail was laid along each main rail about fifty millimetres distant from it, similar to that generally used on bridges, the old rails being used for this purpose, laid on sides. These guard rails, as noted in the illustration, Fig. 1, are bolted to cast-iron bed-plates or chairs, which are in turn bolted to the sleepers. The new track is constructed of rails weighing forty-two kilogrammes per metre of length and they are fastened to and supported by wooden sleepers and steel chairs. These heavier rails are twelve metres in length, and eighteen sleepers are employed for this length, the sleepers being thoroughly embedded in the broken basalt ballast, 15,000 cubic metres of the same being used.

This track construction has proved entirely adequate for the excessively high speeds attained, as in spite of the high speeds of 201 kilometres and 207 kilometres per hour no disturbing facts were noted during the various runs. The passengers were able to stand and take notes and write sitting, without difficulty.

Some trouble resulted some time ago from the vibration of the three-line conductors and poles noted at the side of the track in Fig. 1, but this was remedied by making the collecting bows lighter, fitting them with better springs. These changes, together with an improved arrangement of the conducting wires, eliminated the drawbacks and dangers from the oscillations of the poles and conductors which were the cause of the fractures and short-circuits.

The line is divided into sections one kilometre in length and a feeder connects the centre of each section. As will be seen in the photograph the three conductors are mounted one above the other vertically, the lowest being about twenty feet from the ground and the distance of the line from the track being about seven or eight feet. A pole is located every 100 feet, and on each is mounted a bow-shaped arm upon which the high-tension wires are suspended, not rigidly fastened, but supported by insulators of hard rub-

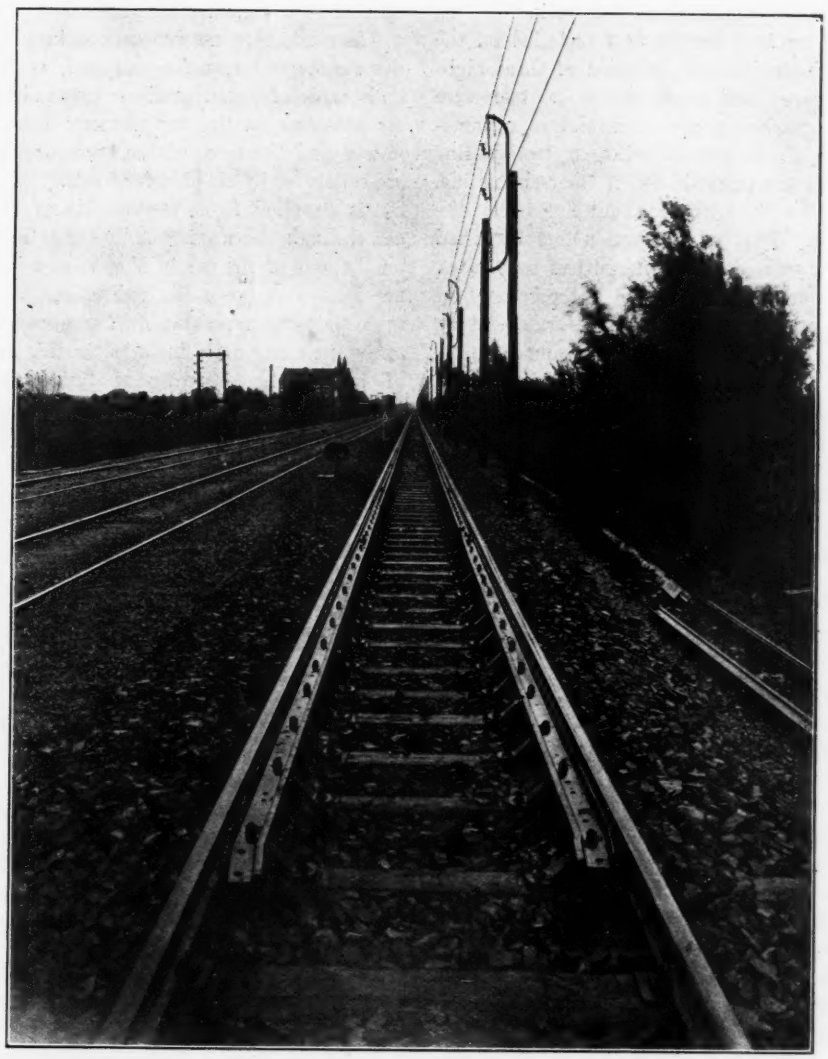


FIG. 1.—NEW ROADBED, BERLIN-ZOSSEN HIGH-SPEED ROAD.

ber mounted upon a vertical chain and wire system. Each of the three hard drawn copper conductors has ninety-seven per cent conductivity and has a cross-section of 100 square millimetres.

A loop of wire about one-third of an inch in diameter, as will be seen in illustration Fig. 1, is fixed at each supporting insulator in such a manner that in case the trolley wire breaks, it will be grounded by being pulled into contact with a vertically suspended wire of the same cross-section, having a coil spring near its upper support, its lower end being directly connected to the track.

The four feeders first installed on the high-tension line consisted of three high-voltage conductors and a neutral wire mounted on porcelain insulators, connecting the Marienfelde-Zossen trolley line with the power-house at Oberschönweide, on the river Spree, about five miles distant. Part of the conductors consisted of insulated cables and part of bare wires, the cross-section of the latter being fifty square millimetres and the former having a cross-section of seventy square millimetres.

The voltage was increased for the last speed trials, the tension on the transmission line being raised to 14,000 or 15,000 volts.

The motor car which was used to make the very high speeds recently attained on the Berlin-Zossen has been reconstructed as to trucks, collectors and other apparatus. The trucks are somewhat longer than the old ones used on the first motor car trials, the wheel-base of the new equipment being five metres instead of 3.8 metres of the old construction, and the central pivot is allowed a lateral movement. The motors have been changed somewhat and connected one on each end axle, the centre axle running free. The wheels are a trifle over four feet in diameter and are equipped with pneumatic brakes, each cylinder serving two brake shoes, the pressure used being six atmospheres, giving a total brake-pressure of double the car weight. The car is practically the same as first constructed, being twenty-two metres in length, with platform at each end about two metres in length from which the operator controls the car. The Westinghouse air brakes are so arranged that they may be operated from either end of the car, and the compressed air was not only installed to operate the brakes but also for controlling the electrical apparatus as well. The car weighs about 100 tons, the body and running gear weighing somewhat more than the electrical equipment, consisting of switches, transformers, motors, and other controlling apparatus, and an electrically operated air pump with its transformer.

Each motor has a normal capacity of 250 horse-power, making a total of 1,000 horse-power for the four motors, but they are capable of handling a load of 500 horse-power each or 2,000 horse-power when called upon for a considerable period, and may be even worked to a capacity of 3,000 horse-power for a short time while starting. For excessively high speeds, the voltage and frequency are increased to a considerable extent.

There has been no difficulty in keeping the motors and transformers cool, as the high rates of speed produce tremendous air pressures on the car of many atmospheres and the cores of the transformers are connected by air pipe for cooling. The air is supplied from the outside of the car through the numerous openings seen on the side of the car in Fig. 2, and this air blast also keeps the resistances used at a proper temperature. Three resistances were originally installed in this car of large size, consisting of twenty-five coils and three smaller resistances of four coils each, one for each of the three phases. The six-pole motors were directly connected to the car wheel axles, the normal speed being 900 revolutions per minute and the diameter of the wheels 1,250 millimetres. These motors were provided with three collector rings upon each of which eight brushes pressed for giving the necessary contact. The rotors measured about thirty inches in diameter and the slots of the motor were well insulated with mica, wooden wedges being used to hold the bar winding in place together with the usual wire bands. The primary winding has ninety-six slots and the secondary seventy-two slots, the motor having a six-pole winding. The motor receives the current from the three-phase step-down transformers at from 1,150 volts to 1,850 volts, it being lowered to the former pressure from 10,000 volts.

Before the road-bed was reconstructed the Allgemeine Elektricitäts Gesellschaft, of Berlin, also supplied a motor car which attained very high speeds, and this company will now make additional trials, beginning with moderate speeds, before attempting the high speeds attained by the car of the Siemens-Schuckert Werke. The current for operating the railway is supplied from the power-house of the General Electric Company (the Allgemeine Elektricitäts Gesellschaft), the station being located at Oberschönweide. The motor cars were built by Van der Zypen & Charlier, of Cologne, Germany.

The Seimens & Halske electric locomotive was designed for four motors, two on each truck, but at first only two motors were installed, one on each bogie, with single-reduction gearing. In a test at 11,000 volts and drawing a trailer of thirty-one tons weight a speed of 100 kilometres and over was attained with an output of 280 horse-power. It has been reported that on another test a total weight of 130 tons was hauled, which included the heavy high-speed car above mentioned as attaining the recent high speeds, and the results were highly satisfactory.

The experiments on the Berlin-Zossen line were commenced in 1901, and the object was to demonstrate the possibility of attaining speeds of 200 kilometres per hour under practical conditions, and this was the highest speed expected to be obtained. This enormous speed was reached and passed on October 6, the trials on this date ranging from 180 kilometres to 201 kilometres per hour, the frequency used being forty-six cycles per second and the pressure 14,000 volts. The curve of 2,000 metres radius was taken at a speed of 165 to 170 kilometres per hour with perfectly smooth running and without the slightest trouble. The maximum authorized speed of 126 miles per hour was reached on the above date, thus giving the anticipated results. The total distance of twenty-three kilometres, or somewhat over fourteen miles, was traversed a number of times in about eight minutes, including the starting and braking. On about five kilometres of track on the Rangdorf-Dahlwitz-Mahlow section it is claimed only one and one-half minutes were required to make the entire distance.

On October 23 a speed of 207 kilometres per hour was made by this car, according to a letter received from the Siemens-Schuckert Werke. At this rate of speed the total distance from Cologne to Berlin, about 577 kilometres, would be covered in less than three hours, while the present quickest actual time is about three times as long, or about nine hours. It is stated that the power consumed was about 1,000 horse-power by the four motors of the car in these trials, and in this connection it is of interest to note some data given by G. B. Lochner, in April, 1902, before the Berlin Society of Railroad Engineering as to the results of the tests made on the Berlin-Zossen high-speed line at that time.

He stated that in starting with an acceleration of from 0.1 to 0.2 metre per

second, from 500 horse-power to 1,000 horse-power was required, while at a uniform speed of 140 kilometres per hour the consumption of power in the car was only 245 horse-power.

It was stated that the power consumption increases very rapidly as the rate of speed is increased, particularly on account of the air resistance, and that if a speed of 200 kilometres per hour was attained, which is 124 miles per hour, somewhat more than 1,000 horse-power would be required. It was reported that in the experimental plant the efficiency of the whole installation was low as the power was located at a great distance and the drop in potential was heavy on the line from the plant to the road, being greater than that along the entire railway, while the power-factor of the motors was not over 0.6, as they were never fully loaded.

Within from 2,000 to 3,200 metres the speed of sixty-two miles an hour was attained in from two minutes and eighteen seconds to three minutes and thirty seconds, which is an acceleration of from 0.13 to 0.2 metre per second. It is stated that the motors of the motor car were capable of developing 3,000 horse-power for a short period and that only from 700 to 1,000 horse-power was ever tried. Higher accelerations were not attempted, as the power-house generators were not capable of taking care of rapid and heavy variations of load.

Mr. Lockner's conclusions were that from the tests the braking arrangements were not sufficient, as with speeds of over 120 kilometres per hour the signals could not be observed within a proper time to bring the train to a stop even in clear weather, while in rainy weather it was even worse. The tests showed conclusively that there was no practical difficulties in using polyphase motors for high-speed runs, ample cooling being possible with an air draft. It was also clearly demonstrated that at even the highest speeds there would be no difficulty in supplying the necessary high-tension polyphase currents from the trolley wires through the contact bows as indicated in the arrangement with the Siemens & Halske car.

From the recent trials it has been shown that Mr. Lockner's conclusions were correct, as no difficulty was found in collecting the current required for the motors at the highest speeds, reaching finally about 130 miles per hour. The experiments of the Allgemeine Elektricitäts Gesellschaft will be awaited with interest by all engineers engaged in electrical traction work.

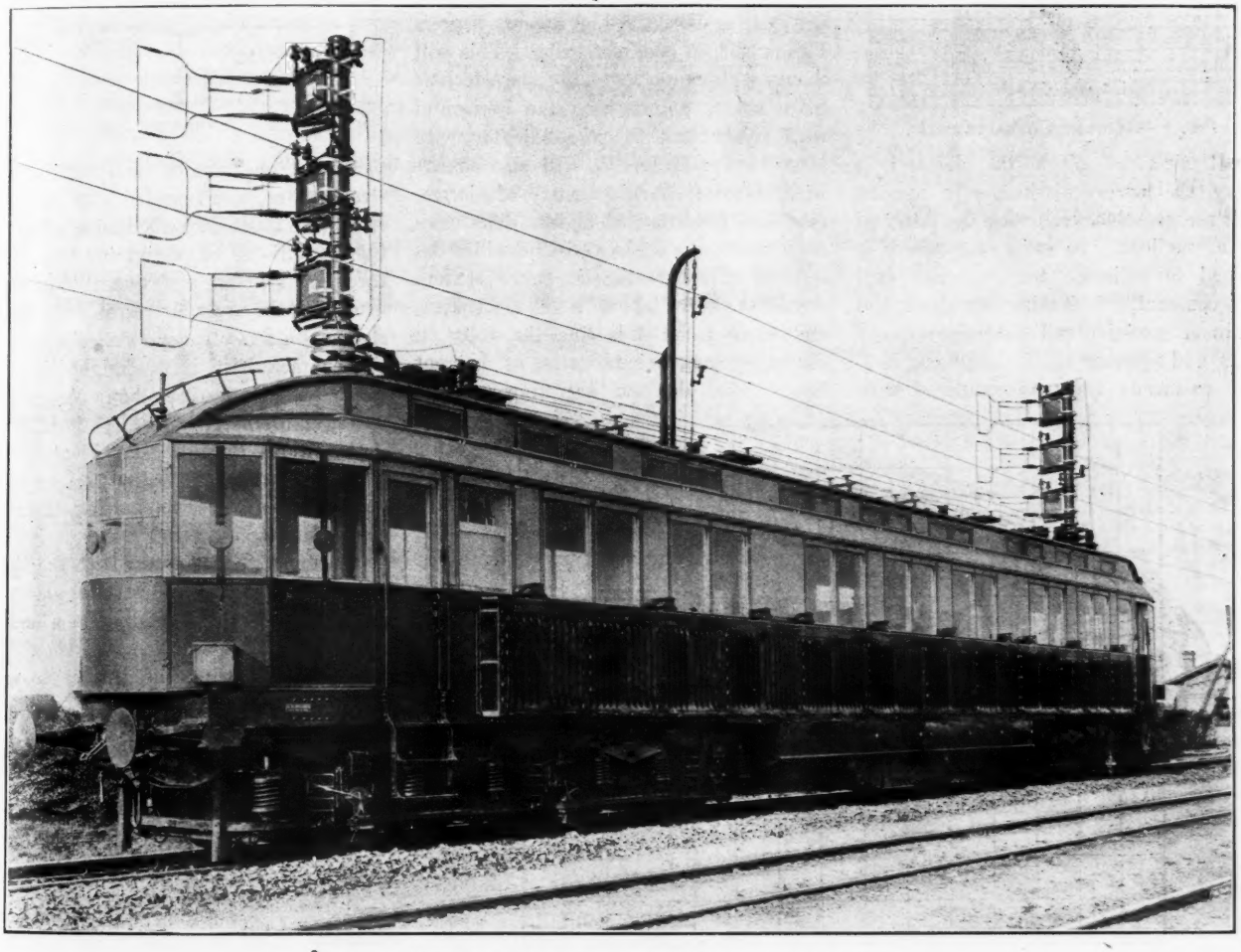


FIG. 2.—HIGH-SPEED CAR OF THE SIEMENS-SCHUCKERT COMPANY.

Transactions of the American Institute of Electrical Engineers.

The October number of the transactions of the American Institute of Electrical Engineers is being distributed. This number contains the paper and discussions presented at the Niagara Falls convention, on July 2 and 3, 1903. The papers include one by J. W. Esterline and C. J. Reed upon "The Factors Which Affect the Energy Losses in Armature Cores;" one on "Central Station Economies," by W. E. Goldsborough and P. E. Fansler; "A Legalized Standard of Electromotive Force," by Henry S. Carhart; and "The Cathode Ray Alternating-Current Wave Indicator," by Harris J. Ryan. On July 3 the papers related to technical education.

This number also gives the papers and discussions on hydroelectric installations read at the New York meeting, September 25, 1903.

THE COMPARATIVE BEHAVIOR OF FLOATING AND BOOSTER-CONTROLLED BATTERIES ON FLUCTUATING LOADS.[1]

BY LAMAR LYNDON.

Methods of Application—The object of using the storage battery as a regulator on variable loads is to absorb, as far as possible, all fluctuations above or below the average current. When the external load is light, the generator sends current into the battery as well as to the external circuit. When the demand is heavy, the battery discharges in parallel with the generator, relieving the latter of the excess load. In some instances it is desired to maintain the generator current constant, eliminating the shock and strain of excessive and suddenly imposed loads, and to secure the fuel economy incident to steady loads as compared with fluctuating. In other cases, the object is to maintain a constant voltage on a circuit or rather to prevent it from varying more than a predetermined amount. Obviously, the maintenance of absolutely constant load, or voltage, is the ideal condition, and the more nearly this is approached the more nearly is the object attained.

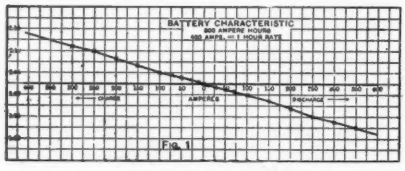


Fig. 1.—Battery Characteristic.

Where the load is applied some distance from the power station, there are five possible methods of installing a storage battery to maintain the load on the generator reasonably constant, which are:

(1) Floating battery in power station.

(2) Floating battery, out on line, at point of application of load.

(3) Battery with booster, in power station.

(4) Battery and booster, out on line, at point of application of the load.

(5) Battery out on line, at point of application of the load, and booster in the power station.

Cell Characteristic—Fig. 1 shows the characteristic of an 800-ampere-hour cell one quarter discharged, at seventy degrees Fahrenheit, in good condition. This will change with temperature, the characteristic more nearly approaching the horizontal with higher, and the perpendicular, with lower, temperature. It will also change with state of charge, density of electrolyte, and condition of plates. The ordinates above the horizontal line which intersects the characteristic curve at zero represent the voltage of a cell on charge, and those below this line the volts on discharge, at various rates of current flow. The abscissæ are amperes, the curve being extended on either side of the zero at that point where the current flow is equal to the one-hour rate of charge or discharge. Each reading was taken twenty seconds after beginning of the corresponding current flow. The zero point shows the voltage of a cell when current flows neither into nor out of it.

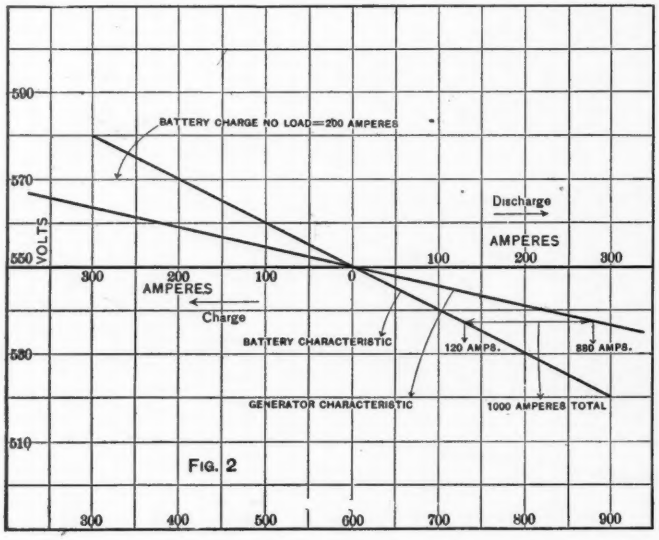


Fig. 2.—Generator Amperes.

This is the general form of characteristic for nearly any type or size of cell, the conditions of charge, temperature, electrolyte, density, etc., being the same. The data then to construct the characteristic for any size of battery of same state of charge, temperature, and electrolyte density as given are:

Volts per cell at zero, 2.025; at the one-hour discharge rate 1.915, and at the one-hour charge rate 2.14. Connect these points by a straight line. As may be seen, the one shown is practically a straight line, and repeated tests on many sizes and types of cells indicate that if the conditions be maintained constant throughout a test and due allowance be made for the error in reading the small changes in the voltmeter deflections, that the characteristic is a straight line between the points of one-hour charge and one-hour discharge rates.

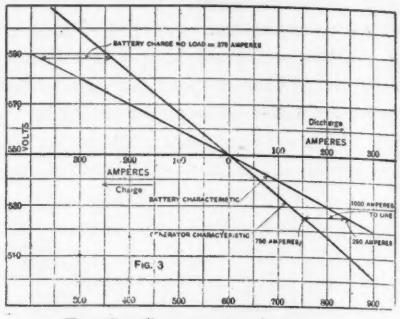


Fig. 3.—Generator Amperes.

Conditions Necessary for Floating—If a storage battery be "floated" on a system on which the load is fluctuating, the voltage of the circuit across which it is connected must obviously vary with the load; rising above that of the battery when the demand is light and sending in a charging current, falling when the demand is heavy and allowing the battery to discharge and assist the generator. In order that the system may work properly there should be a relationship between the battery characteristic and that of the generator. The greater the inclination of the generator characteristic to the horizontal, that is, the greater the change in voltage with change in load, the greater will be the battery discharge on loads in excess of the normal or average load. Referring to Figs. 2 and 3. In Fig. 2 the generator characteristic has a certain inclination to the horizontal.

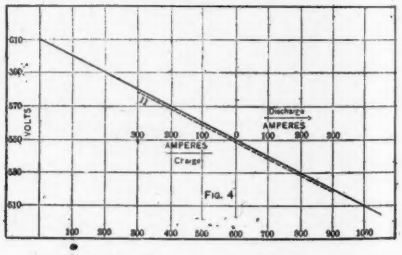


Fig. 4.—Generator Amperes.

[1] A paper presented at the 181st meeting of the American Institute of Electrical Engineers, New York, November 20, 1903.

The battery characteristic is superimposed on it, the point of zero current flow intersecting the generator curve at the point of normal load—600 amperes. For simplicity both are here assumed to be straight lines. When 1,000 amperes are sent over the line, the generator furnishes 880 and the battery 120 amperes, the increase in load on the generator being 280 amperes, or forty-seven per cent.

In Fig. 3 the inclination of the generator characteristic is greater than in Fig. 2, and for 1,000 amperes station output, the generator furnishes 750 amperes, the battery 250, the increase of generator load above normal being 150 amperes, or twenty-five per cent. In the latter case, however, on light load, the voltage rises so greatly that an excessive current will pass into the battery, probably injuring it. As the one-hour rate of charge should never be exceeded—and even this should last but a very short time—the relative inclination of the two characteristics must come within certain limits. Furthermore, large shunt generators of high efficiency can not be made—or, at least, certainly are not made—so that the full-load voltage decreases more than fifteen per cent below the no-load voltage. This limits the inclination of the generator characteristic.

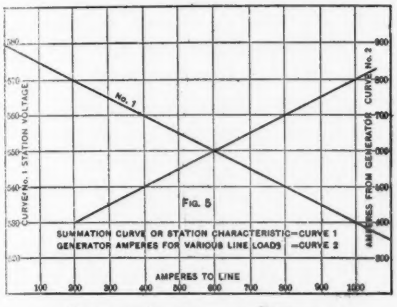

CURVE No. 1 STATION VOLTAGE
AMPERES FROM GENERATOR CURVE No. 2
No. 1
No. 2
AMPERES TO LINE
SUMMATION CURVE OR STATION CHARACTERISTIC—CURVE 1
GENERATOR AMPERES FOR VARIOUS LINE LOADS —CURVE 2
Fig. 5.

FIG. 5.—SUMMATION CURVES.

CASE I—FLOATING BATTERY IN STATION.

Data of System—Consider the case of a fluctuating load such as is shown in curve A, Fig. 7. The minimum current is 260, maximum 1,000, and average 600 amperes. Such a load coming directly on the generating equipment must result in low efficiency and high fuel consumption per horse-power-hour; and will require generators with large overload capacity and heavy engines to withstand the strains imposed. It may here be mentioned that the load curve shown is not an assumed one, but represents the actual readings made on an operating electric railway.

Assume that this load is carried over one feeder to a point two miles from the power station; that the minimum voltage at any time is to be 350 volts; that the track is of seventy-pound rail, well bonded. Still assuming both characteristics as straight lines, Fig. 4 is drawn. Line "I" is the generator characteristic. The dotted line running just underneath "I" is the characteristic of a 600-ampere-hour battery, the one-hour charge or discharge rate of which is 300 amperes. This line is in reality coincident with the generator curve. The voltage of the generator at normal load, 600 amperes, is 550 volts, which is also the open-circuit voltage of the battery. The ordinates are volts as indicated. The lower set of abscissæ are amperes of generator output; the set on the horizontal line at 550 volts are amperes of charge or discharge of the battery.

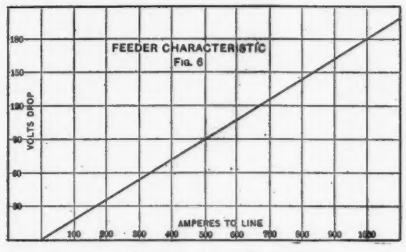


FIG. 6.—FEEDER CHARACTERISTIC.

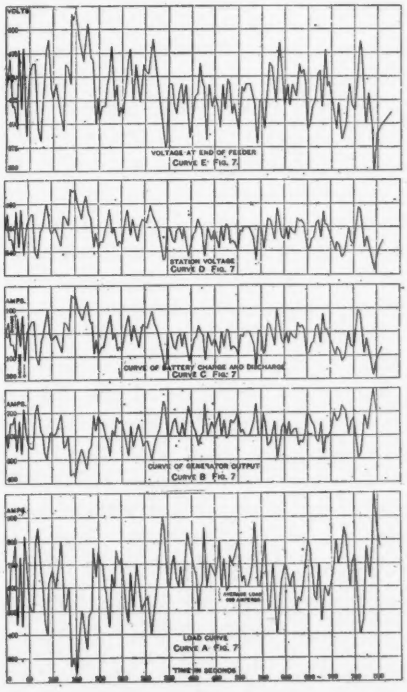


FIG. 7.—CURVES FROM FOREGOING DATA.

Summation Curve—Fig. 5 shows a summation curve which gives the station voltage at any output to the external circuit and is constructed as follows.

At voltage of 530 the generator output is 800 amperes, the battery discharge 200; total, 1,000 amperes to the line at this voltage. Similarly, at 540 volts the sum of the two outputs = 700 + 100 = 800; at 560 volts the generator output = 500 amperes and the current going into the battery = 100 amperes; hence the line current = 500 — 100 = 400. Likewise, at 570 volts, line current = 400 — 200 = 200 amperes. In this way the points on the summation curve are located which give line current as the abscissæ and station voltage as the ordinates. Since the characteristics are both straight lines, the summation curve is also a straight line. In this case only two points have to be located and joined together, but in many cases where the generator characteristic is a curve, the summation line becomes a curve and several points must be located to trace it. For this reason the method of tracing is here set forth.

Line Constants—From Fig. 5 it may be seen that the station voltage at 1,000 amperes is 530 volts. Since the minimum voltage at the delivery point two miles distant must not fall below 350 volts, the total line-drop must not exceed 180 volts, which fixes the resistance at 0.18 ohm. The resistance of two miles of well-bonded seventy-pound rails is 0.0582 ohm. This leaves 0.1218 ohm as the copper resistance, or 0.0609 ohm per mile, corresponding to 940,000 circular mils. Taking this resistance, the curve of line drop at various loads is plotted, which is shown in Fig. 6. This is, of course, a straight line.

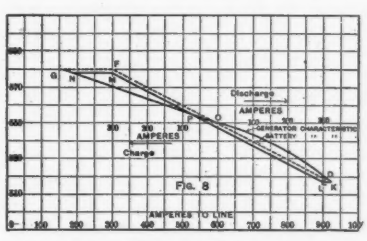


FIG. 8.—DROOPING GENERATOR CHARACTERISTIC.

Derived Diagrams—From the foregoing data and figures the curves in Fig. 7 are derived. Curve A is the load diagram before mentioned. The next curve B shows the generator load. Curve C shows the current to or from the battery. Curve D shows the variation in station voltage with the load, and curve E shows the voltage changes at the feeding point, being plotted by subtracting from the ordinates of D the feeder drop for the various currents. Since all the relations are of the first order, the various curves are of the same form as the load curve. Curves D and E are also of the same

form, but reversed, being inverse functions of the load curve.

A study of these curves reveals the following:

(1) The voltage at the station falls off rapidly with increase of load (curve D, Fig. 7).

(2) Only two-thirds of the capacity of the battery to discharge are utilized. It can discharge at the rate of 300 amperes, and only 200 amperes are drawn from it at the instant of the maximum peak (Fig. 4).

(3) Because of the fall in station voltage with load, the copper required on the line is excessive, and the voltage at the feeding point unsatisfactory, as shown by curve E.

(4) The fluctuations on the generator are greatly reduced, and the capacity of the generating equipment may be decreased in the ratio of eight to ten, or twenty per cent.

Drooping Generator Characteristic—All the foregoing is based on straight generator characteristic. As a matter of fact, however, it would be of the form shown in Fig. 8. This change, from a theoretical straight characteristic to the actual drooping one, introduces complications. If the battery characteristic intersect that of the generator at the point of normal load—600 amperes—as indicated by the dotted line, the discharge on heavy loads will be greater than in the previous case, since the inclination of any element of the curved portion to the horizontal is greater than that of the straight-line characteristic, and a larger portion of the load will be taken by the battery. But it may also be seen that with the same light loads as before, the battery-charging current is less than in the previous case.

Relation between Input and Output—In any battery used for regulation, it is necessary that the input approximately equal the output, otherwise the state of battery charge is changed and the efficiency of the regulation decreased. If the input exceed the output, the excess energy will be lost, going off in the form of free gases from the cells, and the high voltage due to overcharging decreases the current which may be sent into the battery on light load, thus permitting more fluctuation of the generator load. Furthermore, continuous overcharge will ruin a battery, if persisted in.

If the output exceed the input, electrical bankruptcy follows and the battery is in no condition to help the generator when most needed.

From Fig. 8 it may be seen that the input and output are to each other inversely as the two areas on either side of the intersection of the generator and battery characteristics, which are formed by the spaces included between the two characteristics and closed by horizontal lines which are drawn through the points of voltage at maximum charge and discharge. That is,

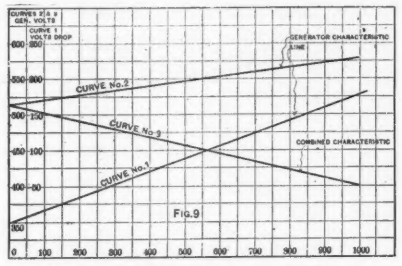


FIG. 9.— CHARACTERISTIC OF OVER-COMPOUNDED GENERATOR.

the areas O D E and O F G are to each other inversely as the battery input is to the output. The point O is not necessarily the intersection with the line of average external load, but is the point of intersection of the two characteristics. Obviously, therefore, the battery characteristic must be moved downward, increasing O F G and diminishing O D E until these two areas are equal, the resulting areas being P M N and P L K. This means that the normal battery voltage is lowered, its zero point being shifted downward. With the normal load of 600 amperes on the line, there will now be a charging current into the battery of twenty amperes, making the generator current 620 amperes and lowering the station voltage to 548 volts.

Conditions with Drooping Characteristic—The conditions are then manifestly less advantageous in the actual case than in the theoretical case first discussed and in either case are worse than they would be with an over-compounded generator in the power station working without a battery. A mere reduction of mechanical strains and fuel-consumption is of little

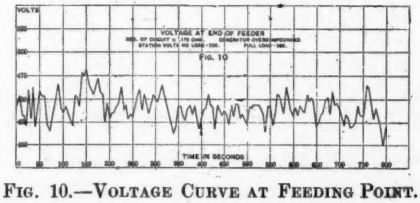


FIG. 10.—VOLTAGE CURVE AT FEEDING POINT.

avail if the cars on the system can not be accelerated, carried over grades and schedules maintained.

Compound Generator—For comparison with the previous cases, Figs. 9 and 10 are shown. In Fig. 9 are plotted the characteristic of an over-compound generator, the line characteristic with resistance 0.18 ohm as before and a combination of these showing the total characteristic for the feeding point. From this last, the curve in Fig. 10, which is the voltage curve at the feeding point, is plotted. This is drawn to the same scale as curve "E," Fig. 7, and a comparison of these two curves shows the superiority of the over-compounded generator working alone. The minimum voltage in the former case is 350, in the latter 401; and the maxima are 522 and 482 volts, respectively. If 350 volts are sufficient for satisfactory operation, the resistance of the circuit may be increased from 0.18 to 0.23 ohm. Deducting the track resistance, 0.0582 ohm, the copper resistance becomes 0.1718 ohm which corresponds to 665,000 circular mils, as against 946,000 circular mils in the first case—a reduction of twenty-nine per cent.

CASE II—FLOATING BATTERY OUT ON THE LINE.

Data of System—Consider now the case of a floating battery located at the feed point—two miles away from the station: assume an over-compounded generator giving 520 volts at no load, and 580 volts at full load of 800 amperes, and assume further that the battery will discharge 200 amperes at maximum load of 1,000 amperes, giving 800 amperes as the maximum transmitted over the line. If the minimum voltage allowable be 350 volts, the resistance = 0.287 ohm or 0.288 ohm for the copper resistance, corresponding to 495,000 circular mils or twenty-five per cent less copper than that required in the case of the compound-wound generator working alone.

Fig 11 shows the generator characteristic, the line characteristic, the combined characteristic, and the characteristic of a 600-ampere-hour, 392-volt battery. This shows that when the maximum load of 1,000 amperes comes on the system the generator supplies 700 amperes, the battery 300, and the voltage is 371.

Derived Diagrams—In Fig. 12 are shown the summation curve of Fig. 11, giving the voltage at the feeder point for any current to the line, and the line No. 2 which shows the relation between the amperes flowing over the line and the current from the generator. Fig 13 shows the three curves, B the load on the generator; C the current to or from the battery, and D the voltage at the feed point all for the same load curve shown in A, Fig. 7. All these are to the same scale as the corresponding curves in Fig. 7 and may be readily compared therewith.

Excessive Charge Rate—The only ob-

jectionable feature in this system is that the charging current when there is no load on the line at no load would be far in excess of the permissible rate. This is shown both in Figs. 11 and 12. In Fig. 12 the voltage at zero line load is seen to be 425 volts, which on the combined characteristic in Fig. 11 corresponds to a current flow over the feeder of 450 amperes. If there is any possibility of the line ever being relieved of load, some provision must be made for avoiding this excessive charge. In the system under discussion, however, this never occurs.

Results—The location of the floating battery at the feeding point shows manifest and undoubted improvement in that it not only performs all the functions of equalization with the production of the accompanying benefits, but the copper and size of generator are so much decreased that the saving is greater than the cost of the battery, so that the first cost of the system is less than in the case of a generator without the battery auxiliary.

It is to be noted that the voltage at the feeding point, with average line load, is 392 volts, which is also the open-circuit voltage of the battery. In the case of the battery located in the power station, the floating voltage required is 550. The number of cells in series in the former instance is 194, and in the latter 271; so that the cost of the battery is diminished in this ratio, or twenty-eight per cent. Also this changes the slope of the battery characteristic. The 550-volt battery shows thirty volts increase above normal for the one-hour charge rate, and the same amount below normal for the one-hour discharge rate. In Fig 11 it may be seen that the variation above or below normal for the one-hour rate of charge or discharge is 21.5 volts due to the smaller number of cells in series. The change in the voltage of the individual cells is, of course, the same in either case.

Overcharge—In practice it is necessary to overcharge or "boil" the cells occasionally to maintain them in good condition. The voltage on overcharge rises to about 2.6 volts per cell or thirty per cent more than the normal voltage. Thus a battery which has a floating voltage of 550 volts would require a potential of 715 volts at the terminals to give a proper overcharge. Since it is seldom possible to increase the station voltage to such a figure, it becomes necessary when "boiling" to connect the battery so that it is divided into two portions, each having an equal number of cells in series. These two halves are then connected in parallel across the line. As the required voltage to overcharge is now halved, proper resistances must be inserted between each set of cells and the line. Generally, the ordinary water-barrel rheostat is used. Since overcharge need only be given ten or twelve times a year, this is not a continuous condition of operation.

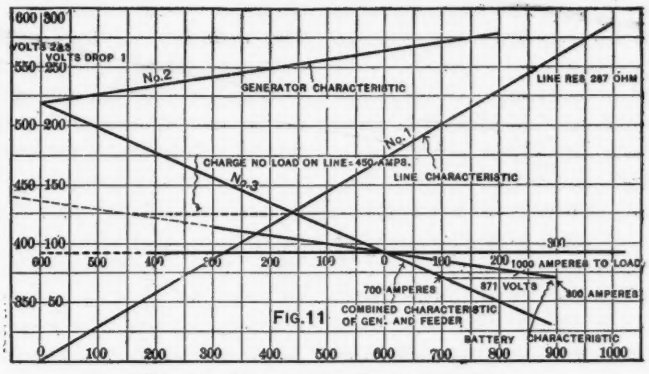


FIG. 11.—COMBINATION CHARACTERISTICS.

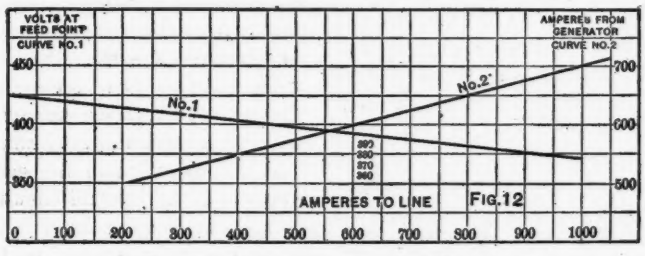


FIG. 12.—SUMMATION CURVE OF FIG. 11.

Where the battery floats at the end of a long feeder of fairly high resistance, which is heavily loaded, the normal battery voltage is lower than that of the station, and during the early hours of the morning, when for half or three-quarters of an hour the load may be thrown off the feeder, the decrease in feeder-drop, together with full generator excitation, may bring the voltage at the battery terminals up sufficiently high to give it the required overcharge. In the case just cited, the voltage at the feed point with seventy-five amperes passing over the line (which current is ample for boiling a 600-ampere-hour battery) is 502 volts. The potential required at the battery is $194 \times 2.6 = 503$ volts. A very slight increase in the generator voltage will, therefore, meet the re-

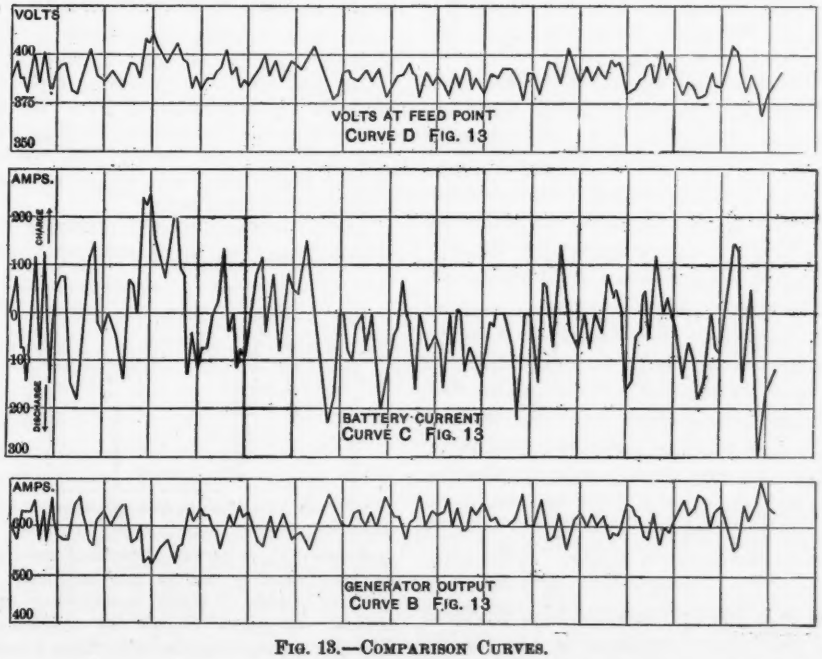


FIG. 13.—COMPARISON CURVES.

quirement, if the feeder be entirely relieved of other load.

COMPARISON CASES I AND II.

The results, then, of locating a battery out on the line as compared with the use of the generator working alone are:

(1) Load on generator is maintained much more constant as indicated in curve B, Fig. 13.

(2) Copper cost is greatly reduced.

(3) Voltage varies much less and with less copper, the minimum voltage is increased.

Also the full capacity of the battery is utilized, which was not the case when floated in the station.

BOOSTER SYSTEMS.

In discussing the operation of the two batteries previously considered, with booster auxiliaries, it is proper here to indicate how, and under what conditions, automatic boosters operate. There are two generic types of regulating boosters: one in which slight changes of line voltage cause changes in field excitation to produce charge or discharge; in the other the field excitation is varied by the changes in external load.

Fig. 14 shows an example of the first-mentioned type: G is a shunt-wound generator, B the booster armature, E the battery, and MM the motors or variable load on the system. The driving motor is not shown. The operation of this booster is as follows: at normal load, the voltage of the battery is equal to that of the line, and as no current flows either into or out of it, the series field S is not excited and the booster voltage is zero. On increase of external load, the generator tends to send out additional current, causing a slight decrease in line voltage. The battery then begins to discharge and the field S being energized by the outgoing current, induces an electromotive force to assist the discharge, or in other words, adds an electromotive force to the battery electromotive force equal to the drop due to discharge. This added electromotive force compensates for the battery drop whatever the rate of discharge, since both vary directly as the outflowing current. Conversely, if the load decreases, the line voltage will rise slightly, causing the beginning of a charge. The direction of the current now being reversed in the coils, the electromotive force produced in the booster armature is also in the opposite direction and assists in forcing the charge into the battery. Since the rise in battery voltage on charge and the booster electromotive force both increase proportionally to the current, the rise in battery electromotive force is practically compensated for. Therefore, within small percentages the voltage is maintained constant, regardless of the rate of battery charge or discharge, and from this it follows that the load on the generator is also kept constant. Obviously, this booster is operative only on systems having a falling characteristic with load increase; that is, with a shunt generator, if the battery is located in the power-house or on a feeder, the drop through which exceeds the increase in voltage at the generator terminals, if the system is fed by a compound-wound dynamo.

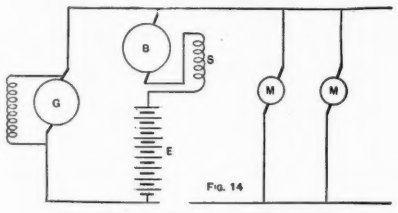


FIG. 14.—REGULATING BOOSTER.

The second type of booster is shown in Fig. 15. In this the battery voltage is equal to that of the line, and at normal load the excitation of the series field S, which is in the external circuit, is exactly equal to that of the shunt field *f*. These being oppositely wound, neutralize, and the booster voltage is zero. If the external load be increased, the excitation of S overpowers that of *f* and there results a booster electromotive force proportional to the increase in external load and in a direction to cause the battery to discharge. Should the load decrease, the shunt field is the predominant one and produces an electromotive force in the booster armature to cause a charging current to flow into the battery. This booster can be used either with shunt or compound-wound machines.

These diagrams merely illustrate the salient principles of booster operation,

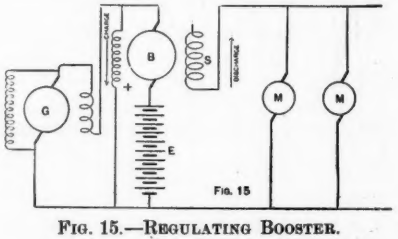


FIG. 15.—REGULATING BOOSTER.

and are not complete, practical devices, as additional windings are required to produce points of stable equilibrium and prevent excessive charge or discharge. There is a large number of different types having various windings and connected in ways peculiar to the ideas of the inventors, or the limiting factors of existing patents. These two, however, show the principles on which they all work.

(To be concluded.)

Two New Books.

The J. B. Lippincott Company, publishers, Washington square, Philadelphia, will shortly bring out "The Mechanical Engineer's Reference Book," by Henry Harrison Suplee. Mr. Suplee is editor of the *Engineering Magazine*, of New York and London, and a member of the American Society of Mechanical Engineers and several foreign societies. He is universally recognized as one of the foremost authorities in his field, and the new volume is intended to form a standard handbook for the mechanical engineer and designer of machinery, supplying, in convenient form, the general information which is constantly required. This is not to be an old book under the disguise of a new edition, but is the first edition ever printed, thoroughly up to date, set in new type, and with illustrations especially made for it. The work embraces mathematical tables, principles of statics and dynamics, machine design, materials of construction, hydraulics and hydrostatics, steam engineering, heat motors, the mechanical applications of electricity and modern machine shop methods, including works management and systems, cost keeping, intensified production, and the general relations of engineering to production.

The James T. Allen Patents Publishing Company, Washington, D. C., will shortly issue "A Digest of United States Patents on Wireless Telegraphy (Space)," under fifteen subdivisions, years 1789 to January, 1904. This digest is being compiled by permission of the Honorable Commissioner of Patents from the records of the United States Patent Office, and will include all of the American patents issued on wireless telegraphy between the dates above mentioned. The work will contain 500 pages of drawings and the specifications and claims in full. It will also contain all of the reissues, designs and trade-marks granted during the above period, accompanied by the full specifications and claims. Especial care is being bestowed upon the arrangement of patents, to simplify and facilitate expert, validity and preliminary examinations, and, to this end, the patents will be arranged chronologically under fifteen subdivisions. A general alphabetical index will be provided, in which will be given a complete list of the references cited, by number, name and date; interferences; parties thereto, and decisions while the applications—now patents—were being examined in the United States Patent Office. The digest will be in one volume, and the edition will be limited. The price has been fixed at $25; foreign subscriptions, $30. It will be ready for delivery in the early part of 1904.

Notes on Steam Turbine Electric Generating Plants.

At a meeting of the Leeds local section of the British Institution of Electrical Engineers, Mr. George Wilkinson read a paper on steam turbine generating plants. Mr. Wilkinson first described briefly the historical development of the Parsons, De Laval and Curtis turbines, and the method of construction. He then discussed the value of this prime mover, as compared with the reciprocating engine.

The economy of space and buildings was set forth by comparing the 3,500-kilowatt Sulzer-Kolben two-phase generators at the Willesden works of the Metropolitan Electric Supply Company, with turbo-generators of equal output. The Sulzer-Kolben plant weighs, with condensers, approximately 585 tons. The space occupied by the foundations is sixty feet two inches in length by twenty-one feet six inches in width, with a vertical height above the engine room floor to the top of the piston tail rods of thirty-three feet four one-half inches. A Parsons turbo-generator of the same output weighs approximately 148 tons, and the space occupied does not exceed thirty-seven feet one inch in length by eight feet in width and fourteen feet six inches in height, plus about an equal depth for the condenser room beneath. A Curtis turbo-generator of 5,000-kilowatt output weighs approximately 175 tons, and the space occupied does not exceed twenty feet by fifteen feet, with a vertical height not exceeding thirty feet. In this size the condenser, turbine and generator are arranged vertically, the condenser forming the base of the plant.

According to the published data, the maximum steam consumption guaranteed by the builders of the Sulzer-Kolben plant works out with saturated steam at 150 pounds pressure and a vacuum of twenty-four inches at 22.2 pounds per kilowatt-hour at full load, twenty-three pounds per kilowatt-hour at half load. The makers of the Parsons turbo-generator guarantee the steam consumption, with steam at 150 pounds pressure, vacuum of twenty-eight inches, and superheat of 100 degrees Fahrenheit, at 17.5 pounds per kilowatt-hour at full load, and twenty pounds per kilowatt-hour at half load. A further interesting comparison in this respect is given between the most enconomical of the two 1,400-kilowatt two-phase plants with triple vertical engines recently installed in the Leeds electricity works and the 1,750-horse-power direct-current turbo plants installed last year in the works of the Newcastle and District Electric Lighting Company.

	Speed.	Superheat.	Kilowatts	Steam Pressure.	Vacuum.	Water per Kilowatt-Hour.
				lb.	in.	lb.
Leeds	200	.76° F.	1,400	183	25.6	19.9
Newcastle	1,710	237° F.	897	145	26.5	17.73

Tests on a 500-kilowatt turbo-generator have shown an improvement in steam consumption resulting from a superheat of fifty degrees Fahrenheit of about eight per cent, and at 100 degrees Fahrenheit it averages about twelve per cent, and the author believes that by using very high superheat further economy in steam will be obtained in this direction provided the vanes at the high-pressure end of the turbo are made of a metal which does not become brittle at high temperatures. In the case of large engines of the usual types it is not advisable to superheat the steam by more than 200 degrees Fahrenheit, and in some cases there is much trouble with the valves if the superheat exceeds 150 degrees Fahrenheit, but in the steam turbine there are no such limitations.

So long as proper adjustments are maintained between the fixed and moving vanes, the efficiency as to steam consumption appears to be well maintained. This view is confirmed by the following tests taken on a 300-kilowatt Parsons turbo-generator under his own control, in which the tests made at the Harrogate electricity works in February, 1902, are compared with tests made in the same works and under precisely the same conditions after over nineteen months' heavy work. It will be noted that the results of the 1903 tests are better than those of 1902, which may be partially owing to the increased speed, but chiefly to the fact that the number of the vanes in the high-pressure end were found broken off on opening out after the test of 1902.

TESTS OF 300-KILOWATT TURBO-GENERATOR AT HARROGATE.

Date of Test.	Steam Pressure.	Superheat.	Vacuum.	Load in Kilowatts.	Speed.	Pounds Steam per Kilowatt-Hour.
	lb.	lb.	in.			
Feb. 19, 1902.						
Full load	130.5	41.9° F.	28	309.5	3,010	22.76
Half load	131	45° F.	28.8	157.4	3,010	25.1
Sept. 30, 1903.						
Full load	130	35° F.	28	307.5	3,080	21.12
Half load	130	38° F.	28	127.1	3,080	23.24

In the discussion of the paper, Mr. Holiday said that he had found there was a resistance of one megohm between the spindle of the turbine and the frame of the bearings, due to the film of oil in the bearings. In regard to oil economy, Mr. S. D. Schofield had found it necessary to use expensive lubricating oil, and had had some trouble due to the oil mixing with water, but this was overcome by filtering the oil. Mr. Stoney said that, with a 1,500-kilowatt machine, they were obtaining results two per cent better now than sixteen months ago, and that they saved $25 a week in oil for a load of 600 kilowatts, the equivalent of a saving of about two pounds of steam per kilowatt-hour.

Mr. W. J. A. London had no difficulty in synchronizing a 3,000-kilowatt Parsons-Brown-Boveri rotary turbine with a slow-speed engine, and he said that the overall length of the 5,500-kilowatt turbine for the London Underground Railway would be about forty feet, which compared favorably with any slow-speed, horizontal, reciprocating steam engine. The total weight of the combined plant was about 200 tons, about one-third of the 3,500-kilowatt Sulzer-Kloben plant. While with a Continental firm he found that the oil consumption for 1,000-kilowatt units was, for a reciprocating engine, four gallons of engine oil, four gallons of cylinder oil and four gallons of filtered oil for twenty-four hours. With the steam turbine 0.8 gallon of engine oil and 0.4 cylinder oil were used. With oil at ordinary prices, and a station having ten of these units, there would be a saving in the oil bill of $10,000 per year by the use of steam turbines.

Mr. Samuelson said that, by superheating 100 degrees, the steam consumption was reduced one pound. Assuming the consumption to be nineteen pounds, there would be a saving of ten per cent.

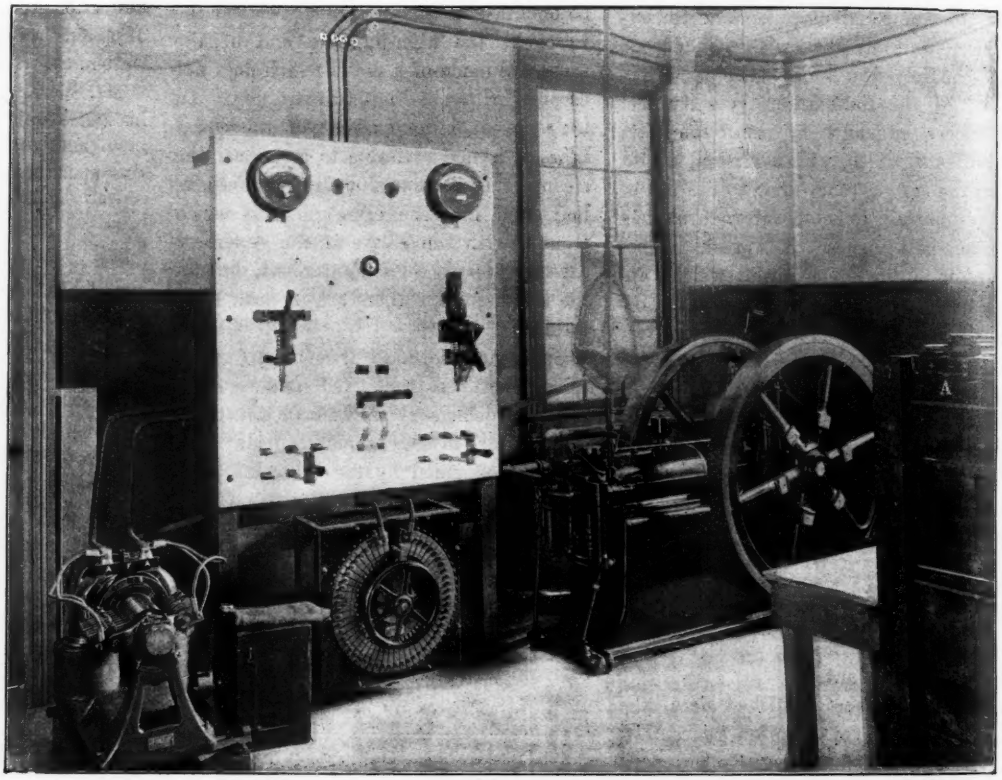
The last session of the University of Pennsylvania appropriated $25,000 to equip a laboratory for X-ray research and Finsen's light apparatus at the Hospital of the University of Pennsylvania. Dr. Henry K. Pancoast has charge of the work.

HOW THE UNITED STATES GOVERNMENT USES ELECTRICITY.

BY J. E. PRICE.

What is the United States Government doing in the electrical field, in the use of electricity as motive power and otherwise? Well, the government knows a good thing, and is not slow to adopt anything of merit.

In nearly every department of the government at Washington electricity is used—for light, elevator or other service. The electric current now runs every press—by directly-connected motor—in the Bureau of Engraving and Printing, where two thousand men and women are engaged in turning out gold and silver certificates, bonds, revenue and postage stamps. Millions of the latter are turned out every year for this country, Porto Rico, Guam and the Philippines. This work is done entirely by electrical power, and the process is quite interesting. The plates—vignettes, numbers and lettering—are all engraved in the Bureau, and, after being printed on electrically driven presses, in sheets of one-hundred stamps to the sheet, they are sent to the gumming machines. Here they pass under gumming rollers, thence through a long heated box, from which they come out dry. Now they are put through an automatic electric perforating machine which makes the little holes that divides each stamp from the others on the sheet. After this the sheets are put in an hydraulic press and smoothed, and the process is completed.



PART OF THE ELECTROPLATING OUTFIT, MAP MAKING DEPARTMENT, UNITED STATES COAST AND GEODETIC SURVEY.

Next to the Washington Navy Yard, the Government Printing Office is the largest user of electricity of all of Uncle Sam's working-places. The new printing office, not long since finished, is the most complete of its kind in the world. It is a huge brick structure, seven stories high, fronting 175 feet on North Capitol street and 408 feet on G street. It has 400,000 feet of floor space and contains 12,000,000 bricks, 14,000,000 pounds of steel and 2,500,000 pounds of cast iron. There are fifteen elevators in the building, a refrigerating plant for cooling drinking water, and drinking fountains at convenient places.

All the Printing Office machinery is moved by electric power. There are over one hundred printing-presses, each with a direct-connected motor. In the power-house there are four engines, two of 800 horse-power, one of 400 horse-power and one of 250 horse-power. The battery consists of eight boilers of 300 horse-power each.

The working force of this great establishment consists of about 4,000 people, one-third being women. There are 900 book-binders, 1,200 compositors, 100 pressmen, 200 press-feeders, about 600 folders, 260 stitchers, 55 stereotypers and electrotypers; and besides these there are hydraulic pressmen, engineers, electricians, firemen, boxers, counters, watchmen, etc.

Until quite recently the Washington Navy Yard has been running the greater part of its machinery, for gun, gun-carriage making and numerous other purposes, by steam alone. Now the electric motor is seen in nearly all the navy yard shops. The electrical equipment there is excellent, and is being improved from time to time as Congress makes appropriation for such improvement.

The electrical outfit of this yard consists principally of one generating set of a 600-horse-power, McIntosh & Seymour engine, direct-connected to a 400-kilowatt, General Electric generator; one set consisting of one 125-horse-power Ball & Wood engine, direct-connected to a forty-kilowatt, 115-volt, General Electric generator; two generating sets consisting of a 300-horse-power, cross-compound, Ball & Wood engine, direct-connected to two 100-kilowatt, 115-volt, General Electric generators. All are connected with the Edison three-wire system. The 400-kilowatt generator is connected with the outside bus-bars. The every-day load is 3,600 amperes.

In most cases in the navy yard shops the electric motors are located in the galleries high overhead, operating the machinery below by means of belts, but there are a number of small motors, from one to four horse-power, on lathes, shapers and milling machines, direct-connected.

The Washington Navy Yard gun plant is said to be the best equipped in the world. It is certainly a huge one. The great gun shop alone covers about two acres, and with its new extension is 1,000 feet long by eighty feet wide. The gun-

carriage shop is almost as large; and there are others in the plant-building system which are of great dimensions, among them the foundry, occupying 22,000 square feet, and the forge shop, 13,500 square feet. The whole navy yard acreage now, by recent addition, is about ninety acres.

In this big war material manufactory there is a vast amount of machinery and all of this will soon be run by electricity. Nearly all of the fifteen lifting cranes—one of which carries 110 tons—are run by this power, and even the models, upon the lines of which government ships are constructed, are towed through the water by electric power.

These models—in hull-shape of warships—are constructed in a big shop in the navy yard, where twenty-three electric motors are altogether employed for power. When finished the models are taken for trial to the model testing tank in a brick building 500 feet long by fifty feet wide, and there put in the water and attached by a steel arm (rod) to a carriage. The latter spans the tank, on both sides of which is a rail track. The carriage has four trucks to each of which is attached an electric motor, the aggregate capacity of the latter being 300 horse-power. The speed of the tank carriage varies from one-tenth of the knot (ten feet per minute) to twenty knots per hour (2,000 feet per minute). The resistance of the model against the water is measured by a spring, the forward end of which, attached to a bracket, is screwed forward or back by means of an electric motor. A rigid arm extends from the bracket and marks its position with a pencil on a recording drum. The after end of the spring is connected with the towing rod which draws the model. These automatic appliances—all on the moving carriage—are so nicely adjusted that they record time, distance and resistance during each run of the model.

Two other places where Uncle Sam employs the electric current to do his work are the Coast and Geodetic Survey and the Bureau of Standards. The functions of the latter place consist in the custody of the standards; the comparison of the standards used in scientific investigation, engineering, manufacturing, commerce and educational institutions, with the standards adopted or recognized by the government; the construction when necessary of new standards, their multiples and subdivisions; the testing and calibration of standard measuring apparatus; the solution of problems which arise in connection with standards; the determination of physical constants and the properties of materials. At present the Bureau is giving its attention principally to length measures, weights, capacity measures, thermometers, polariscope apparatus, hydrometers, resistances (electric), standards of electromotive force and direct-current measuring apparatus.

Some of the rooms of the Bureau building (the office has not yet been moved to the new edifice just outside of Washington) are crowded with various kinds of testing instruments, largely electrical, many delicate and beautifully finished.

The power for running machinery for making and testing instruments at this place is supplied by a gas engine and an electric generator of nine kilowatts capacity. Besides this there is employed a storage battery of 132 cells for reserve and power, when the engine is not running.

The Bureau has comparatively recently received from England an electrostatic voltmeter which will be the standard for comparing such meters.

In the Coast and Geodetic Survey electricity is used principally as a working force in electroplating. Here maps and charts are made of land and water; thousands of miles of coasts must be looked after, and all the trackless paths of ocean and lake must be charted. And when maps and charts are made they are engraved upon large copper plates and put through the electroplating process. Some of the plates are about three by four feet in size. The electroplating plant is now run by a gas engine of six horse-power which drives an electric generator, furnishing a maximum current of 300 amperes at ten volts.

The Coast and Geodetic Survey also has a magnetic outfit for detecting measuring and telling the direction of magnetic currents. This is done by a photographic process. Three magnets, each balanced perpendicularly in an air-tight glass cylinder, are used. Running from each magnet is a boxed channel way, the three meeting in one channel, at the end of which is situated a recording drum revolved by clockwork and carrying a wide band of sensitized photographic paper. The drum revolves continually night and day, and the position of each magnet, by means of a spot of light centered upon it, is continually reflected upon the sensitized paper and photographically recorded. When there has been magnetic disturbance, causing the needles (magnets) to waver, the record appears in zigzag lines; when current is absent the lines are perfectly straight.

The knowledge thus gained is used principally in correcting the mariner's and surveyor's compass; but from data gathered in this connection it is said that it may also be used in forecasting coming earthquakes. It has been frequently noticed by scientists that great magnetic disturbance has preceded earthquakes.

The United States Weather Bureau, where maps are made and from which forecasts issue, is a user of electricity; the new War College, consisting of more than twenty buildings, now being erected on the Arsenal grounds in Washington, will be a large user of current in its work.

Programme of the Annual Meeting of the American Society of Mechanical Engineers.

The programme for the annual meeting of the American Society of Mechanical Engineers, to be held in New York, December 1 to 4, 1903, is as follows:

"The Money Value of Technical Training," presidential address by Mr. J. M. Dodge; "Is Anything the Matter with Piece Work," by Mr. Frank Richards; "Modifying Systems of Management," by Mr. H. L. Gantt; "Slide-Rules for the Machine Shop as Part of the Taylor System of Management," by Mr. C. G. Barth; "What Are the New Machine Tools to Be?" by Mr. J. E. Sweet; "Suggestions for Shop Construction," by Mr. F. A. Scheffler; "The Pitot Tube," by Mr. W. B. Gregory; "Methods of Determining Rates and Prices for Electric Power," by Mr. F. B. Perry; "Three and Four-Wire Multiple-Voltage Systems," by Mr. L. A. Gillet; "Test of a Compound Engine Using Superheated Steam," by Mr. D. S. Jacobus; "The Pressure Temperature Curve of Sulphurous Anhydride," by Mr. E. F. Miller; "Construction and Efficiency of a Fleming Four-Valve Engine," by Mr. B. T. Allen; "A Compact Gas Engine of the Beam Type," by Mr. C. H. Morgan; "Standard Unit of Refrigeration," by Mr. J. C. Bertsch; "Series Distilling Apparatus of High Efficiency," by Mr. W. F. M. Goss; "Air Motors and Air Hammers; Apparatus and Methods for Testing," by Mr. M. H. Wickhorst; "Valve Motion of Duplex Air Compressors," by Mr. S. H. Bunnell. The sessions will be held at the following places: the opening session of Tuesday evening, December 1, at the society's house, 12 West Thirty-first street; Wednesday morning, December 2, at Mendelssohn Hall, 113 West Fortieth street; Thursday morning, December 3, at Stevens Institute of Technology, Hoboken, N. J.; Friday morning, December 4, the concluding session at the society's house. The excursion and social numbers on the programme are: on Wednesday afternoon, visits to various large central power stations; Wednesday evening is left open; Thursday afternoon, inspection of Stevens Institute; Thursday evening, reception at Sherry's, Forty-fourth street and Fifth avenue; Friday afternoon, excursion to the works of the De Laval Steam Turbine Company, Trenton, N. J.

NOTES ON X-LIGHT.

BY WILLIAM ROLLINS.

NOTE CLXXIII—FURTHER APPARATUS REQUIRED IN PUMPING X-LIGHT TUBES.

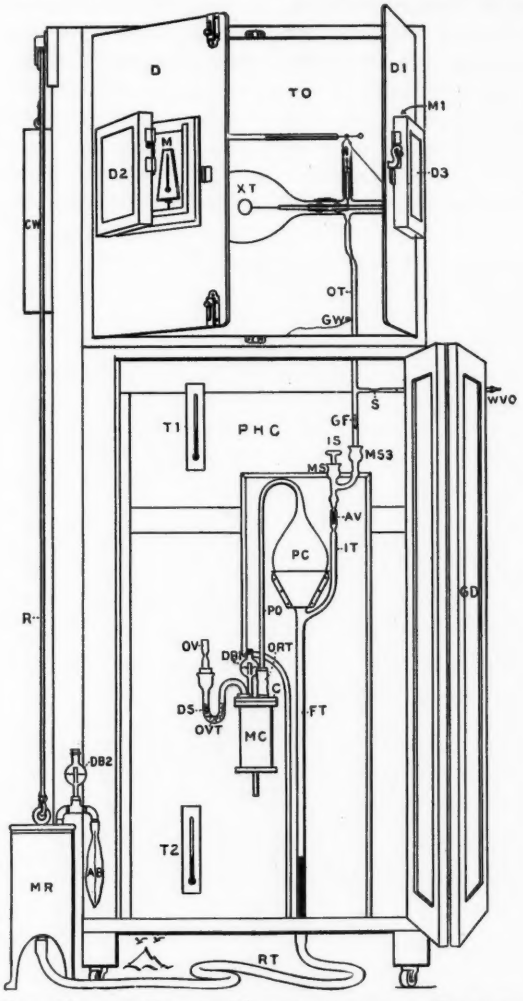
To any one who has studied the history of the mercury pump, the difficulty of saying anything new will be evident. About the only originality which can be shown is in a judicious selection and combination of valuable features, useless ones being discarded. The former are few, the latter so many it seems as if the object had been to complicate the pump.

If it is important to rapidly obtain the highest vacuum, the pump and vessel to be exhausted should be of one piece of glass without joints, drying tubes, gauges or stopcocks; the pump and vessel to be exhausted being hot.

When the calibre of the pump increases or diminishes, the change should be gradual, to allow the mercury to sweep off gases and vapors from the glass. A pump of this kind might be called the Swedenborg-Mile-Rood-Pump, for Swedenborg invented the first mercury pump in 1722, Mile added the barometric tubes on the inlet and outlet, and the rising and falling mercury reservoir in 1828. Rood, in 1880, showed that the pump should be hot. If all the other men who have worked on the hand mercury pump had never existed, it would to-day be as efficient. As the highest vacua are of no value in X-light tubes, though supposed to be necessary, a pump for exhausting them may well have its efficiency slightly diminished if it is made more convenient. A pump of this kind suited especially for experiments where it is desirable to collect the gases or measure the degree of exhaustion, is shown in Fig. 2. Mile's barometric tube on the inlet is replaced by a short, wide tube IT with a stopcock IS, only a little above the outlet tube. This construction was made possible by the invention of the automatic valve AV by Mitscherlich in 1873. In his valuable pamphlet "The Development of the Mercurial Air Pump," Thompson states, on page 23, that a stopcock between the vessel to be exhausted and the pump is worse than useless. As the experiments mentioned in these notes could only be made at night, on account of daily professional duties, it was necessary to economize time in pumping the X-light tubes. Preventing water vapor in the air from entering the pump (while standing unused) by means of a stopcock IS on the inlet tube was found to reduce the time required to exhaust the tubes. This is so important, it will be stated as another X-light axiom —water vapor should be kept out of the mercury exhaust pump.

Before the stopcock IS is opened, most of the water vapor should be removed from the X-light tube by heat and a small hand exhaust pump, attached by a flexible rubber tube at WVO, a partial vacuum being produced. The tube S is then sealed; IS being opened and the exhaustion finished with the mercury pump. Where the latter is not worked by hand, as in the figure, but by a mechanical pump, as recommended in note cxxxviii, the preliminary exhaustion should be directly into the mechanical pump.

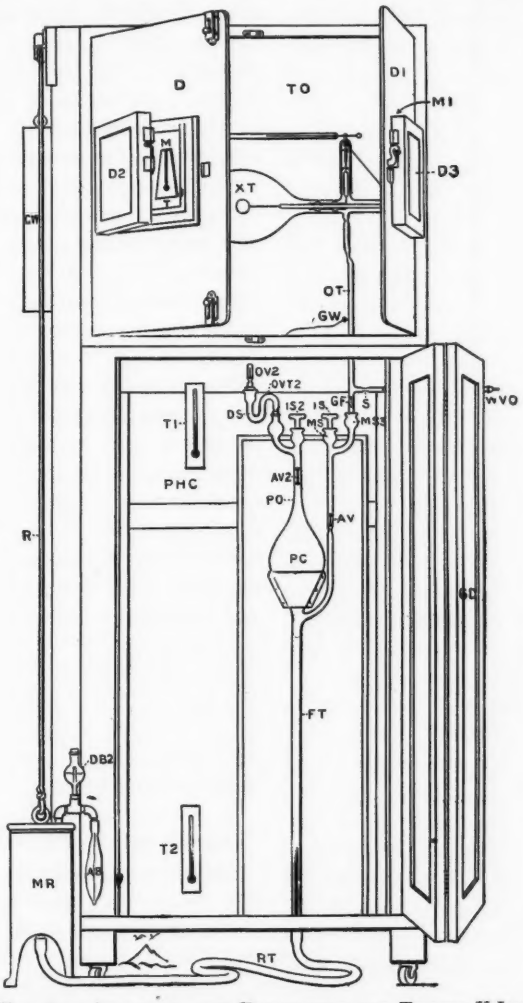
One never sees a mercury pump without a drying tube between the pump and the vessel being exhausted. Usually it is sealed to the pump as shown in Fig. 1, note clxx. The temptation then is to allow the drying salt to remain too long, for the pump must be taken apart before new drying salt can be introduced. If a drying tube is used, it should be attached by a ground point, as imaginary leaks from such joints do less harm than damp drying salt. But to those who are not bound by tradition, the discarding of the drying tube is recommended. Therefore, it is not shown in the pump illustrated. Details of apparatus for preventing water vapor from entering the pump from the mercury reservoir having been given in note clxx only the method of applying the principle to the pump outlet will be here considered. In Fig. 2, Mile's barometric outlet tube PO ends in a vessel MC provided with a tight cover



NOTE 173, FIG. 2.—HAND MERCURY EXHAUST PUMP ARRANGED FOR EXHAUSTING X-LIGHT TUBES.

Front view of tube oven and pumping arrangements. TO, tube oven with non-radiable walls. D and DI, non-radiable doors. M and MI, mica windows. D2 and D3, non-radiable lead glass doors. XT, X-light tube. OT, tube connecting X-light tube with the pump. GW, grounding wire on outlet tube. S, tube connecting X light tube with mechanical exhaust pump. GF, gold foil to prevent mercury from entering the X-light tube. MS3, mercury seal where the tube OT joins pump. AV, automatic valve. IS, stopcock with mercury seal MS on inlet of pump. PC, pump chamber. FT, fall tube connecting pump chamber with mercury reservoir MR through rubber tube RT. AB, air bag on mercury reservoir. DB2, drying bulb. R, rope connecting mercury reservoir with counterweight CW. PO, pump outlet. ORT, soft rubber tube connecting pump outlet tube with mercury cistern MC. C, cover of mercury cistern. DB, drying bulb. OVT, outlet tube of mercury cistern. DS, drying salt. OV, outlet valve. T, TI, T2, thermometers, which can be read from the outside. PHC, pump hot closet.

C containing three openings, two of which are closed by rubber stoppers, the third by a rubber tube ORT which makes an air-tight connection between the Mile's tube PO and the vessel MC. Through the first rubber stopper passes the tube OVT, closed at the outer end by a valve OV and filled with drying salt ES. The end of this tube, within the vessel MC, extends down over the upturned end of the Mile's outlet tube. As the mercury rises in the pump chamber, it flows over, appearing at the end of the Mile's outlet tube escaping into the vessel MC, the air from the pump arising through the tube OVT, passing out by the valve AV. As the mercury falls in the pump chamber the valve closes, excluding the outer air, retained air being freed from moisture by the drying salt. The soft rubber cylinder ORT connecting the Mile's tube PO with the vessel MC collapses, allowing the mercury to rise again by atmospheric pressure into the Mile's tube. When it is necessary to collect the gases from the vessel being exhausted, the tube OVT with its rubber stopper, is removed, a vial of mercury being inverted over the upturned end of the Mile's tube and held in place by a rubber hand, causing it to fit the hole in the top of the mercury cistern MC. For details of methods of introducing the collected gases into spectrum tubes, refer to Traver's valuable work, "The Study of Gases." In some of the experiments mentioned in earlier notes, while attemptng to find out the nature of the gases in the cathode stream, they were collected in this way, but a surer path was making the X-light tube the spectrum also, by a movable target. The third rubber stopper supports a drying tube DB which keeps the air in the mercury cistern MC dry. No gauge is shown on the pump, for the degree of the vacuum can be measured by having a mark near the upper part of the Mile's outlet tube, in making the necessary calculations. This form of pump, while well suited for investigations on X-light tubes in which it is desirable to collect the gases, is not to be recommended for routine work as the capillary is liable to fracture and care is required to prevent bubbles from rising through the capillary to the pump chamber. In Fig. 2A this capillary tube PO, Fig. 2, is replaced by an automatic valve AV2 which, like the similar one on the inlet AV, Fig. 2, is the invention of Mitscherlich, 1873. When this form of pump is used, the pump can not itself be a gauge, but this is no objection in a pump intended only for routine exhaustion of X-light tubes, therefore no gauge is shown in Fig. 2A. A drying tube like that in Fig. 2 at OVT should be attached to the pump outlet at OVT2, Fig. 2A, and a stopcock IS2 with a mercury seal, to prevent water vapor from entering the pump when standing unused. A pump of this kind should be called the Swedenborg-Mile-Mitscherlich-Rood. These are the only men whose work on the hand mercury pump has been essential for either efficiency or convenience, but to a pump with shortened fall tube to be mechanically operated, the name Robinson must be added. His form is more convenient than a hand pump, if power is available, and the mercury reservoir may be placed within the pump hot closet, rendering the heating of the mercury simpler. In the hand-operated pump, with the mercury reservior external to the hot closet, as shown in the figures, the mercury reservoir may be heated by an electric or gas heater.



NOTE 173, FIG. 2A.—APPARATUS FOR EXHAUSTING AND TUNING X-LIGHT TUBES.

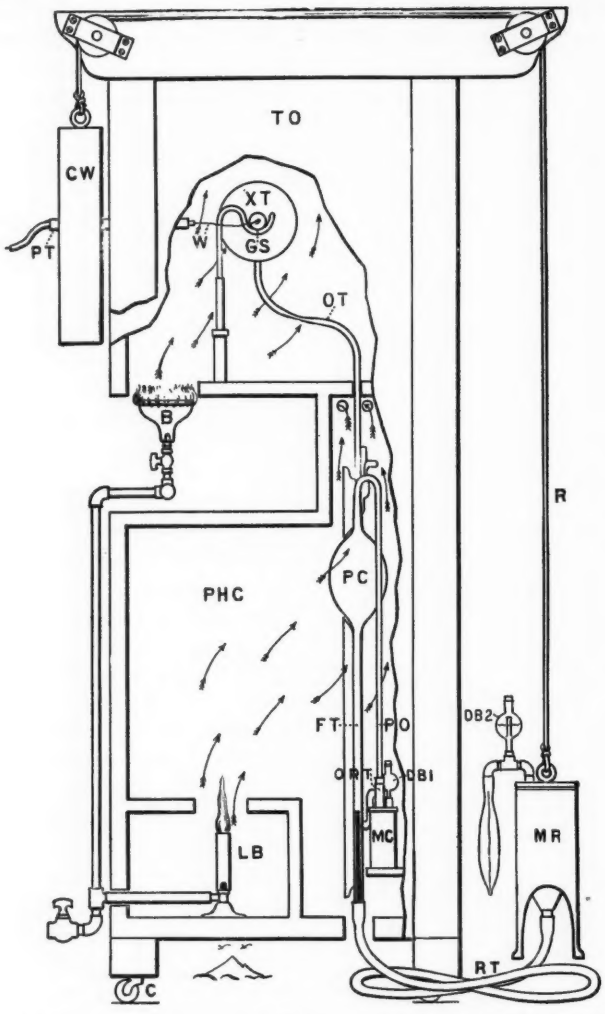
Front view of tube oven and pumping arrangements for routine exhaustion of X-light tubes. TO, tube oven with non-radiable walls. D and DI, non-radiable doors. M and MI, mica windows, D2 and D3, non-radiable lead glass doors. XT, X-light tube. OT, tube connecting X-light tube with the mercury pump. GW, grounding wire on the outlet tube. S, tube connecting the X-light tube with the mechanical exhaust pump. GF, gold foil to prevent mercury from entering the X-light tube. MS3, mercury seal where the tube OT joins the pump. AV, automatic valve. IS, stopcock with mercury seal MS on inlet of the pump. PC, pump chamber. FT, fall tube connecting the pump chamber with the mercury reservoir MR through the rubber tube RT. AB, air bag on mercury reservoir. DB2, drying bulb. R, rope connecting mercury reservoir with counterweight CW. PO, pump outlet. AV2, automatic valve. IS2, stopcock with mercury seal. OVT2, drying tube. DS, drying salt. OV2, outlet valve. T, TI, T2, thermometers.

Heating Arrangements—In earlier notes the necessity of keeping the X-light tube and pump hot was repeatedly mentioned. An arrangement used in the experiments and already described is here illustrated.

Tube Oven—In Figs. 2, 2A and 3 is shown a tube oven TO with non-radiable walls. Its dimensions are sixty by seventy-five by seventy-five centimetres. It is lined with asbestos. There are two doors D and DI, each of which has a window of mica M and MI. The mica windows have doors D2 and D3 glazed with heavy lead glass, three centimetres thick or more. The X-light yielded by the tube can be seen through the mica windows.

When this is not necessary, the mica windows are covered by the glass doors to prevent the operator from being injured by the X-light while pumping and tuning the tube. The importance of this precaution has already been sufficiently pointed out in former notes.

rangement is shown in Fig. 3 at LB. Both oven and pump closet are provided with thermometers which can be read from the outside. Sufficient details for pumping have been given in earlier notes, particularly in note cxxxviii.[1] Directions for operating pumps may be found in the



NOTE 173, FIG. 3.—APPARATUS FOR EXHAUSTING AND TUNING X-LIGHT TUBES.

Side view of tube oven TO and pump; hot closet PHC, with sides partly removed to show interiors. B and LB burners for heating. PC, pump chamber. PO, pump outlet. MC, mercury cistern on pump outlet to which it is connected air-tight by the soft rubber cylinder ORT. DB, drying bulb. MR, mercury reservoir. DB2, drying bulb. AB, air bag. RT, rubber tube connecting the mercury reservoir MR with the tall tube FT. R, rope connecting mercury reservoir with counterweight CW. OT, tube connecting X-light tube XT with the pump. GS, glass fork supporting one end of the X-light tube. W, one of two wires connecting the X-light tube with the electric generator. PT, one of two porcelain tubes insulating wires from the metal walls of the tube oven. C, one of four casters. The arrows indicate heated air.

One end of the X-light tube is attached to the pump by the tube OT, Fig. 2, the other end being supported by the glass stirrup GS, Fig 3, which can be adjusted. The means of heating the oven are shown in Fig. 3; B is one of three gas or kerosene burners. The heat ascends as shown by the arrows, PHC, Figs. 2 and 3, is the pump hot closet. The door D, Fig. 2, is glazed to allow the pump to be examined and folds in the middle to admit of partial opening, when necessary to reach the pump, and yet prevent too much cold air from entering. The heating arwork already mentioned. In former notes, it was said the emanations from the pump should be prevented from entering the X-light tubes during pumping, directions being given for accomplishing this. One means was to place a loose plug of gold foil in the tube going to the pump, to absorb mercury vapor. This is shown in Fig. 2 at GF.

[1] The discharge from the secondary of an induction coil at the time when the current begins to pass through the primary causes the anode to act as a cathode, blackening of the tube from the platinum torn off from the metal. Therefore in exhausting an X-light tube, when the terminals are being electrically treated, to remove the proper amount of amalgamated gas, there should be spark-gaps in series with the tube to prevent the inverse discharge through the tube.

Another was to insert a wire in this outlet tube, the wire being grounded. This is shown in Fig. 2 at GW. In many of the experiments, the coil was grounded for the same purpose. In former notes it was said an X-light tube should be exhausted and subjected to the same current, before it was sealed, that would afterward be used in exciting it, and as it was difficult to obtain satisfactory tubes for powerful apparatus, the suggestion was made in note lxviii to hospitals where X-light was much used, to have their own pumping arrangements. For these reasons, the pumping apparatus here shown is portable, the pump being worked by hand, the weight of the mercury reservoir being balanced by a lead weight illustrated in Fig. 3 at CW. With a hot pump this arrangement is less convenient, as the mercury reservoir is outside the hot closet.

The pump here shown is made of glass, the material always employed. It might be well to try to make a metal pump. Seamless, polished steel tubing can now be obtained and the beautiful electrical welding process of E. Thomson would enable a pump to be made of one piece, the inner sides of the welds being afterward ground smooth and polished. In order to attach the X-light tube, the glass tube connecting it to the pump could be sealed to a seamless platinum tube united with the pump. A pump of this kind instead of being a delicate instrument most suitable for the laboratory, might be a commercial machine.

Cape Town Industrial Exhibition.

The directors of the Cape Town Industrial Exhibition (international) are open to receive offers for lighting the grounds, etc. This exhibition opens in November, 1904, and closes at the end of January, 1905. The address of the managers is Palmerston House, Old Broad street, London, E. C.

Weights of German Continuous-Current Machines.

The following figures quoted by the *Electrician*, London, from a German paper, refer to continuous-current machines made by a leading German firm in 1896 and 1902, respectively. The figures given are based on a speed of 1,000 revolutions per minute.

Capacity of Machine in Kilowatts.	Weight per Kilowatt.	
	1896 (Kg.)	1902 (Kg.)
1	260	150
5	145	74
10	124	68
50	51	26
90	45	21

THE COMBINED USE OF ALTERNATING AND DIRECT CURRENT FOR CENTRAL STATION WORK.

BY PROFESSOR F. C. CALDWELL.

Some twenty years ago the advocates of alternating and direct current were in violent antagonism and many were the heated discussions as to which of these two forms of current distribution was essentially the best; it seemed, at that time, to be a common belief that sooner or later either the alternating or the direct current would gain entire possession of the field. From the standpoint of dividends, and if the pudding is to be judged in the eating, it would seem that in the long run the direct-current men have had the best of the argument, at least under the conditions of the past. How much of this advantage has been due to an essential superiority of the direct current, and how much to the factor of superior organization and management, we will not undertake to discuss.

Conditions, however, have been greatly changed since the time of these debates, and with the enormous increase in the amount of electric energy distributed, and with ever-growing ambition to cover larger fields, the direct-current man has found himself obliged to call upon the alternating current to help him out, nor has the alternating-current man failed to do his share in burying the hatchet.

The question has now become, "In what proportion should the alternating and direct currents be used in any particular plant." There may still be found those who claim that the alternating current is competent to take care of all the business of the central station, but such a stand finds few supporters.

We may, in general, divide plants in which the use of alternating and direct current is combined, into those where the alternating is used for transmission only, the distribution being entirely by direct current, and those where the alternating current shares this function with the direct. There would seem to be little or no justification for the first class, since there must be in any case much work that can be performed by the alternating, at least as well as by the direct current. The second class of plants may be discussed, first for the case of new or entirely reorganized plants, and second for that of the extension and improvement of plants already installed. In the first case, a plant could be established which would be as near the ideal in all respects as engineering knowledge could make it. This case, while unquestionably the more interesting, is nevertheless seldom met with in practice, it may, however, be well to consider it first and then to notice what modifications will be introduced, because of the fact that the best must be made of parts, at least, of a plant already established.

For convenience, we may consider the problem first from the point of view of the consumer, second from that of the distribution of the current, and third from that of the station.

To the consumer, incandescent lighting is the only important use of electricity, where it is a matter of entire indifference whether the current be alternating or direct, providing only that the frequency of the alternating current is high enough to prevent flickering. When we come to the question of arc lights, there is liable to be a preference which would generally be on the side of the direct-current lamp, because of its greater quietness and steadiness, although occasionally the somewhat superior distribution of the light from the alternating arc might have weight. The Nernst lamp, in so far as it has been developed in this country, is much more satisfactory for alternating than direct current, while, on the other hand, the new Cooper Hewitt mercury vapor lamp can be used only with direct current. Summing up the conditions then for the lighting business, it would appear that the honors are about equal for the alternating and direct currents. What the future developments in the use of the two forms of lamp last mentioned may bring forth remains to be seen, but it is not likely that for some time to come they will constitute a very important factor in the problem.

Turning next to the matter of power, there are doubtless many customers who are quite indifferent as to whether their power be supplied from a direct-current shunt motor or from an induction motor, though at present owing to the greater cost the latter is likely to have weight among such customers. A considerable number, however, which will be larger or smaller according to the character of service, will have a more or less decided preference for the one or the other form of motor. Leaving out the factor of first cost of the motor, probably the larger part of these would want the alternating current on account of the great simplicity of the induction motor and of the small amount of care needed to obtain satisfactory service from it. On the other hand, those that wish for the direct-current motor would generally be more insistent in their demands. Among these by far the most important class for the average central station in the larger towns and cities would be the elevator motor; the importance of this work is shown by a statement that in Chicago it constitutes twelve and one-half per cent of the total output of the central stations. So far the induction motor has proved distinctly unsatisfactory for this work and seems, indeed, entirely incapable of handling the high-speed service of the tall buildings now becoming so common. Not only is the operation of the induction motor unsatisfactory for this purpose, but the heavy and lagging starting current proves a most inconvenient factor in the distribution problem. Another class of work where the induction motor has so far failed to give satisfaction, is that requiring a variable speed. While the speed of the shunt motor can be varied by resistance, either in the field or in the armature, the simple induction motor does not lend itself to such methods of speed reduction, having always a strong tendency to approach to a synchronous speed. Another class of work where it would seem that the induction motor could not give satisfaction is that where it is desired to open the circuit immediately upon the appearance of an overload, as, for instance, in the case of a motor running a large printing-press. On account of the heavy starting current necessary for induction motors, it is impracticable to use with them circuit-breakers or enclosed fuses which are rated at a reasonable per cent above the normal full load current. Traveling crane work and other similar cases where characteristics peculiar to the series motor are required would also in the present state of the art fail to find entire satisfaction in the alternating current, though it is possible that the recent development of the series alternating motor, due to Mr. B. G. Lamme, may alter this condition.

For electrochemical work, direct current alone is available, though the possibility of obtaining the exact voltage needed may make the use of alternating current converted to direct more satisfactory. There are also a number of minor uses of electricity where the one or the other form has a decided advantage; thus for charging batteries and also medical and other small batteries, the direct current alone is available; though, of course, the conversion of the alternating to the direct on the spot with the aid of a rotary converter is always possible; the expense, however, of this method is often prohibitive. On the other hand, the alternating is much

the most available for producing the high-potential high-frequency currents used in the X-ray and other forms of medical manipulation; it is also much the most available for use with the ordinary form of dry electric welding.

In view of these facts it appears that the desirability of one form of current or the other, so far as the consumer is concerned, will depend much upon the class of work, apart from lighting, that is being done; thus in the centre of a large town the elevator problem proves a strong advocate for the direct current, and in manufacturing districts the preference for the direct or alternating would depend upon the class of manufactories that were being supplied. Thus, if the character of the work required an approximately constant speed and was such as to make the care of motors with commutators difficult, the alternating current might have a decided advantage, while if, on the other hand, the work required variable speed, the direct current would be preferred.

Looking at the matter now from the standpoint of the distribution of the current, a rather complicated problem or set of problems presents itself, and it will be well to consider several different cases separately. First, suppose that the generating station, as has been common in the past, is located in the centre of a considerable concentrated load. As between generating and distributing direct current or alternating current, the following advantages are to be noted: for direct current, great simplicity throughout the system and hence less liability to trouble, also an entire absence of danger to life, and an investment for copper in the conductors instead of for insulating materials. On the other hand, these advantages are balanced by the serious disadvantage of the limited area of distribution possible for the ordinary three-wire system. This may in some cases be increased by using 440 volts, but then the problem of a satisfactory lamp presents itself, and seems not yet to have been entirely solved. On the other hand, for alternating current we have the great advantage of an unlimited extension of our distribution, increased distances only requiring higher voltages on the primary circuits. The facility with which the constant-potential alternating current can be converted into constant current for series arc lighting is also a considerable advantage to be credited to the side of the alternating current; likewise is to be noted the facility with which the electromotive force upon the different feeders can be regulated by means of the various inductive voltage regulators. To set against these advantages, however, we find a series of troubles coming from the inductive character of the alternating current, especially when induction motors form a considerable part of the load and the power-factor is consequently low. This has the effect of decreasing the capacity of the lines, transformers and generators and also of seriously affecting their voltage-regulating qualities, though this latter effect has been overcome in the case of one generator now upon the market. With the use of large conductors, especially if the distance between them is considerable and if the load be a lagging one, considerable drop is produced by the inductance. The so-called skin effect also comes in to keep down the size of conductor that is available. Thus, a conductor one inch in diameter has its apparent resistance increased eleven per cent for a sixty-period current, while a conductor of 2,000,000 circular mils would be quite impracticable on account of a similar increase of thirty-five per cent. These facts are doubtless ample warrant for the condition of affairs which we find in general existing in such stations, that is, the generation and supply of direct current for the district immediately surrounding the station, with the use of alternating current for more distant areas.

If, however, as is coming to be more and more the case, all power is generated at one or more distant stations and transformed at substations suitably located to take care of the load, the problem becomes a somewhat more difficult one. As has been shown above, a large part of the demand for current probably ranging from eighty or ninety per cent can be as well met with the alternating as with the direct current, and it certainly seems at first sight rather a useless expenditure to convert the whole output of the substation because from ten to twenty per cent of the load needs a direct current for its proper operation. It would seem advisable to make sure that no other more satisfactory plan could be devised. Thus, might it not be possible to have a general system of distribution by alternating current, supplemented by a 500-volt direct-current power line for the operation of elevators and other motors requiring direct current. It has even been suggested that it might be more economical to install induction motors driving direct-current generators, which in turn should operate the elevator motors, rather than to convert the whole output of the substation for the benefit of this comparatively small part of the whole load. It must be remembered that we are, so far, considering only the case of the establishment of a new plant.

Taking up next the power station, we find some important considerations bearing upon the question. Probably the most vital of these is that of the storage battery, which has come to be regarded by most managers of the larger stations as quite indispensable to satisfactory operation. The battery, of course, makes the use of direct current, at least between its terminals, absolutely essential, and so far as the author knows no satisfactory application of it to the working of alternating-current system has so far been carried out, although it has been suggested that a rotary converter might be placed between the storage battery and the alternating-current system upon which it is floating. Even if this arrangement could be made to work, it would in practice involve so large a converter in order to get the full advantage of the capacity of the battery when used at a one-hour discharge rate, that the expense would probably be prohibitive. The importance of the battery in the larger stations is so great that this might often amount to a determining factor in the problem. On the other hand, we have the present wonderful development of the steam turbine directly connected to alternating-current generators, and it seems doubtful whether the same degree of satisfaction will be possible in applying the steam turbine in direct-current work.

To sum up then the conditions as they appear in the newly established plants of the present day, the evidence seems to favor for the smallest plants having no large concentrated load and little or no elevator work a distribution entirely by alternating currents. For larger stations located near their load centres, there seems to be no doubt about the use of direct current supplemented by the storage battery for the district surrounding the station and including the concentrated load, and the generation of alternating current for transmission to and distribution in the regions more distant from the station. For the generation of power in this case several different arrangements are possible; one of them is the use of double-current generators, but a difficulty presents itself here in that these are usually made for a frequency which is too low for satisfactory lighting. Another plan is the use of the direct-current generator and steam turbine alternator with a rotary converter to connect these, and

make it possible to carry the whole load, when light, on either of the two machines alone. In some cases it may be possible to omit one or the other of the generators, at least temporarily, producing all the power as direct current and converting for the alternating-current distribution, or *vice versa*, according as the demand for one or the other form of current is the greatest. Lastly, comes the case of larger towns where it is desirable to generate the power at a greater or less distance. Here the almost universal practice is to have rotary converter substations at the centre of the concentrated loads, where the alternating current generated at the main power station or stations is converted to direct current; this is then distributed as such with the aid of the battery located in the substation, while the more distant and less concentrated districts are supplied with the alternating current. Here the question of frequency comes in again as a complicating factor. Rotary converters operate more satisfactorily on low frequency, but this is not suitable for lighting purposes; the question therefore must be decided as to whether to sacrifice the best interests of the converter stations and use a frequency of sixty or to use twenty-five periods for the transmission to the substations and to raise the frequency to sixty for use in the suburban districts; of course the relative importance of the two kinds of service would have considerable influence in deciding this question.

We must now consider the effect upon this problem of the adaptation of plants already installed, so as to fit them for modern conditions. Such plants if located near the centre of distribution will generally be direct-current plants and unless the development of business is such as to warrant the establishment of a new generating station at a distance from the centre of distribution, their development will naturally follow the lines that have been laid out above; that is, direct current will be retained for the transmission in the vicinity of the power-house, and alternating-current generators will be added for the more distant districts. If the development of business has been such as to warrant the establishment of a distant generating station, the old power-house will usually become a substation with rotary converters for supplying the old direct-current district; the alternating-current districts being supplied directly from the new generating station. The question then arises as to what shall be done with the generating outfit that has been heretofore used. If this is antiquated it may well be dispensed with entirely or if room will permit maintained simply for emergency work and for times of the peak load of the year during the Christmas holidays; if, however, the direct-current equipment is modern, it will be advisable to consider whether it should not be kept in constant commission to take care of the daily peak, the load being taken care of entirely by the main generating station through the converter during the remainder of the day and night.

Where the station to be remodeled is an alternating-current plant at a distance from the centre of the city, if it has been well located, it will probably be developed into the main generating station, and the question of the establishment of a direct-current rotary converter station in the growing centre of the town will have to be decided. In this case, the factors to be considered are practically the same as in those of establishing a new plant.

In the above discussion it has been assumed that only general power is under consideration. Of course if railway power is also to be furnished, a direct-current supply to that extent at least is, and probably for a long time will be, necessary. This railway current might be made to take care of elevators and other motors needing direct current were it not for the National Code rule prohibiting such usage, so that unless this rule is neglected the question of whether railway power is supplied from the same power-house or not will not materially affect the discussion as given above, except that if it should be considered best to have a special direct-current motor circuit, it would naturally be made of the same voltage as the railway circuit, in order that generators and rotary converters might be switched on to either the railway or the motor circuit at pleasure.

Assuming that the plant is to comprise both alternating and direct-current distribution, the question arises as to what part the direct and alternating currents should take, respectively, in the distribution. Three different arrangements are possible; the districts covered by the direct and alternating currents may be entirely separate, or the alternating and direct currents may both be available to the consumer throughout a considerable part of the system, or the alternating and direct-current districts, while in general seperate, may overlap on their borders. The first of these conditions if practicable financially, would be the most satisfactory to the consumer, making it possible for him to have either form of current as best suited to his particular needs. It is doubtful, however, whether conditions would often permit of such a double distribution unless it were in a case where polyphase alternating currents were used for the general distribution of light and power supplemented by a 500-volt direct-current circuit, used only for such motors as required this current for their satisfactory operation. Otherwise it would seem that the entire separation of the districts covered by the two forms of current would be the only arrangement that could be worked without danger of a considerable amount of friction with customers desiring a different form of current from that most available in their district.

In conclusion, it is interesting to consider the probable effect of future developments upon this problem. There has already been presented to the electrical public a piece of apparatus which may go far toward making the alternating current satisfactory for universal distribution, at least so far as customers are concerned, this is the Cooper Hewitt mercury vapor converter which has been briefly described in the technical papers of the past year, and which was presented before a meeting of the American Institute of Electrical Engineers last July. If this simple instrument does what is hoped for it, and if it is sold at a reasonable price, it should make it possible for any customer upon an alternating-current system to obtain direct current of any amount with a very moderate expenditure. One development of which there is less promise but which we can not help hoping may yet not be a thing of the distant future, is the direct generation of current from fuel. Such current would doubtless be direct, and its generation in this form, if offering a considerable improvement in economy over present methods, would be a great factor in the problem which we have been considering.

National Electric Light Association.

The proceedings of the National Electric Light Association at the Chicago convention were of unusual scope and bulk, papers and discussions alike being of great importance. The work of preparing the annual volume of transactions has, therefore, been formidable, but the secretary hopes to have it ready for use very soon. The volume promises to be not far short of 1,000 pages, which, with its special appendices—one of them in colors—will constitute one of the best efforts of the association made in this direction up to date, and will be of great interest to all the members, particularly those who have been unable to attend the meeting.

The 181st Meeting of the American Institute of Electrical Engineers.

Two Valuable Papers.

THE 181st meeting of the American Institute of Electrical Engineers was held at Carnegie Hall, New York city, November 20. The meeting was called to order by President B. J. Arnold.

The secretary announced the election of thirty-four associate members, and the transfer of the following associate members to full membership:

Walter Ambrose Pearson, New York city; Wynn Meredith, San Francisco, Cal.; Lorin Everett Imlay, Niagara Falls, N. Y.; Bernard Edward Sunny, Chicago, Ill.; John Joseph Carty, New York city; Eugene B. Clark, Chicago, Ill.

The first paper of the evening was by Mr. Lawrence Addicks, of Perth Amboy, N. J., and was entitled "The Electrical Conductivity of Commercial Copper." Mr. Addicks pointed out the importance of a careful study of the properties of copper, and said that the conductivity test was the most satisfactory method for detecting the presence of impurities. It is also interesting to note that commercial copper to-day has a conductivity one per cent better than the purest laboratory copper of forty years ago.

Conductivity is affected by the physical state of the metal, as well as by its chemical constitution. The influence of the chemical impurities most usually met was explained by means of diagrams. These impurities are suboxide of copper, arsenic, antimony, and in some coppers, bismuth. Small quantities of other elements may be met with, but the impurities mentioned are those looked for in low copper. The effect of arsenic or antimony is shown by one diagram, as the two elements have a very similar influence. The conductivity varies inversely as the per cent of these impurities present, and is reduced about five per cent by the presence of 0.01 per cent of arsenic or antimony.

The influence of the suboxide on the conductivity is greater, and the law governing the change of conductivity with per cent of suboxide present is more complex. The curve showing this relation has a crest where the conductivity is greatest, this occurring when there is 0.5 per cent of suboxide present. The decrease in conductivity with decrease in oxygen present may mean that the oxide is in combination with the impurities, rather than with the copper.

The conductivity of copper varies with its physical condition, but is less affected thereby than by the presence of arsenic or antimony. The tensile strength of copper varies almost directly as the reduction in area, and the conductivity drops about 0.1 per cent for every 1,300 pounds gain in tensile strength. The effect of annealing hard-drawn wire is to increase the conductivity, the increase varying with the annealing temperature until, approximately, it is 1,100 degrees. If the temperature is carried beyond this point, the conductivity again decreases. The question arises whether the lower conductivity due to overheating is caused by the absorption of oxygen, or by a change in the physical state. To investigate this it was first attempted to anneal copper in a neutral atmosphere, or to protect it by some non-oxidizable coating, but the results were not very satisfactory. When the overheated wire was immersed in dilute nitric acid until the diameter was considerably reduced, there was no appreciable change in the conductivity. This indicated that any chemical change taking place was uniform throughout the wire. In another test, samples of burned wire were drawn to a small size, reannealed, and then tested; and as the original conductivity was recovered, the tests indicated that the change was of a physical, and not of a chemical, nature.

Microphotographic studies of copper are useful, as they indicate the physical condition. Good cast copper shows a distinct crystalline formation. Where impurities are present, the crystals are smaller and the cleavage is in different directions in the grains. When the copper is rolled and drawn the granular construction is broken down and a fine fibre results; and when the copper is burned or overheated, crystallization begins again. In cast copper the conductivity results from the combined conductivities of the pure copper grains and the impure matrix of cement. When this is rolled, the structure is broken down, and the complex shunt and series circuits are rearranged to better advantage. In handling wire, the cement is softened and all internal strain is equalized. In burning, crystalline growth is started and reverts the metal to the original condition.

In opening the discussion, President Arnold called attention to the need of specifications for copper used in railway work. At present the engineer is usually satisfied to call for ninety-eight per cent conductivity, leaving the rest to the manufacturer. He thought that good service could be done by the manufacturers if they would tell the engineers how specifications for copper should be drawn, and what qualities should be called for.

Mr. F. J. Newbury, of Trenton, said that the conductivity test for the purity of copper was used because it is delicate and easily made. He called attention to the increase in resistance and the decrease in tensile strength of copper wires when stranded. Thus, a stranded wire of a given weight per foot will have a lower tensile strength and a resistance about three per cent greater than a solid wire of equal weight. The change in resistance and tensile strength due to stranding is uncertain, and he suggested that engineers, in calling for stranded wire, specify the qualities required of the individual strands, and not of the complete cable. Good values for commercial copper to-day are about 100 per cent conductivity, with a tensile strength varying from 50,000 to 65,000 pounds per square inch. Sixty-eight thousand pounds can be got, but only with difficulty.

President Arnold did not agree with the suggestion made for specifying the qualities of the individual strands of a cable. The engineer is looking for net results, and is willing to leave the quality of individual strands to the manufacturers.

The second paper of the evening was an excellent one by Mr. Lamar Lyndon, of New York city, entitled "The Comparative Behavior of Floating and Booster-Controlled Batteries on Fluctuating Loads." This paper will be found on another page of this issue. It considers various methods of using storage batteries for reducing the load variations on a station. Each case is considered fully, and a method is given for predetermining the result. The various cases are then compared to show which gives the best results.

President Arnold, in opening the discussion, spoke of the value of studies of this kind. Only a few years ago it was almost impossible to obtain any reliable information upon the performance of the storage battery, and its value for such purposes was questioned by a good number of engineers. To-day the opinion has changed, and is almost unanimously in

favor of batteries for such purposes as here discussed.

Mr. J. R. Appleton, of Philadelphia, emphasized the value of a storage battery for relieving the stress on a station, and he gave as an illustration the experience of a station in California, operating a railroad in connection with a ferry, where, before the installation of the battery, two generators, with an aggregate output of 1,450 kilowatts, had been unable to handle the load satisfactorily, even with a man standing constantly at the throttle of each engine. After the installation of the battery the larger generator, rated at 850 kilowatts, carried the load without any difficulty whatever, although there were variations of 2,600 amperes.

Mr. A. S. Hubbard, of New York, said that in selecting a battery it was desirable to choose one with a large plate surface, so that the battery might be able to take care of the most violent load fluctuations.

Mr. J. L. Woodbridge, of Philadelphia, said that it was impossible to use one battery for both steadying the load on the generator and regulating the voltage out on the line. If both results were necessary, two batteries must be installed.

Professor W. E. Goldsborough, of Purdue University, La Fayette, Ind., described the result of installing a battery in St. Louis. This had been located at the centre of distribution and enabled the company to take down copper enough from the line to pay for the battery and the auxiliary machinery at the station. In his opinion engineers would never be able to get along safely without the storage battery, even if they adopt alternating systems.

Mr. J. W. Lieb, Jr., New York city, said that large generating stations have become so important as to make it imperative to use all possible safeguards against interruption. One of the most important features in station operation is constancy of field excitation, and here the storage battery becomes absolutely essential. The battery is floated on the exciting circuit, and it is desirable not only to prevent the interruption of current, but to prevent serious fluctuations in the voltage of the exciting circuit. At first it was thought that it might be necessary to use a booster of some sort, which would act instantaneously in case of accident to the exciting sets, to prevent a change in voltage on the exciting circuit. However, experimenting with a 10,000-kilowatt installation had shown that the battery alone was all that was required. In direct-current systems of distribution, developed with alternating-current transmission, the storage battery becomes most essential, even more so than in a pure direct-current system, because the disturbances occurring are more violent. In such systems the storage battery installation on the line should be fifteen per cent to thirty per cent of the total generator output at the station. It would be hazardous to undertake a large system without such an auxiliary.

Mr. W. W. Donaldson, of New York city, said that in investigating the behavior of a storage battery installation, it was desirable to study the diurnal activity of the batteries. The battery installed should be of such a capacity that it will work, and not merely smooth out the variations in load of the station. If the battery is put on a line and does zero work in regulating the fluctuations it is of no value. Taking the kilowatt capacity at the one-hour rate as a basis, with a wattmeter placed on the discharge side, with a polarized relay, so as to show discharge, at the end of the day one may find one only has a number of watts registered equal to the discharge capacity at the one-hour rate. This might be termed the diurnal activity of the battery. To his mind, the battery properly installed, with proper booster regulation, should do more than that. The more work that can be done with the battery above zero, the more one is getting for his money. If the battery discharges once a day, it does a certain amount of work; but if it discharges three or four times a day, it does proportionately that much greater work. This question of diurnal activity is not given the consideration it should receive.

Professor Goldsborough also emphasized the importance of selecting a battery of such size that it would have work to do, as this would keep it in better condition. The storage battery not only reduces the load variations to a minimum, and thus makes possible the operation of the station under the best conditions, but it ensures continuity of service. By way of illustration, he spoke of an instance happening in Chicago, where an interruption to the feed-water supply made it necessary to shut down the entire station during a heavy load. When the supply of water had been started again, the problem of throwing on the generators with every light in the city turned on arose, and there was some doubt whether the station would be able to stand the strain. It was done, however, by means of a long rod, which closed all the switches at the same time. Such a contingency could not arise to-day, as, should the power station shut down, the storage battery would carry the entire load.

Mr. Lyndon said that, in preparing his paper, he had endeavored only to cover one phase of the problem. The whole problem was an important one, but a careful study of each case would lead to a proper solution.

The secretary of the Institute, Mr. R. W. Pope, announced that the December meeting would be held in the same room, but after that the place of meeting would be the auditorium of the Chemists' Club, 108 West Fifty-fifth street, New York city.

BOOK REVIEWS.

"Friction and Lubrication." William M. Davis. Pittsburg. The Lubrication Publishing Company. Cloth. 236 pages. 5¾ by 8¼ inches. Numerous illustrations.

This book is written by a practical man who has had a large amount of experience in the handling of lubricating oil, and in making experiments and friction tests on various forms of mechanical devices. The first chapter is devoted to a review of the laws of friction, and simple examples are given to demonstrate these laws. Apparently every condition under which a lubricator can be used is taken up, and the book will, no doubt, be of great practical value to men using machinery of every character.

"Home Mechanics for Amateurs." George M. Hopkins. New York. Munn & Company. Cloth. 370 pages. 6 by 8½ inches. 320 illustrations. Supplied by the ELECTRICAL REVIEW at $1.50.

This book is one of the *Scientific American* series, and is by the author of "Experimental Science." A large number of valuable hints is given by the author for the manipulation of tools and familiar apparatus in the production of ornamental and useful devices. The chapter on the operation of the lathe, both for metal work and woodwork, and instructions about drills and drilling, is very complete, and the treatment is such as will be appreciated by the amateur. A chapter is devoted to the making of model engines and boilers, and this is taken up in a very simple manner, so that even the ordinary mechanic can understand the construction, though it may be entirely out of his line of work. A large part of the book is given up to electricity, the whole of part seven being devoted to this subject. Under this head are taken up the construction of a practical primary battery, an electric chime, a home-made electric night lamp, an electrical cabinet, a simple electric motor, how to make a sewing-machine motor without castings, a design for an electric launch motor, the Edison dynamo or motor, the utilization of 110-volt electric circuits for small furnace work, recording telegraph for amateurs, and how to make telephones and telephone calls.

Reviews of Current Engineering and Scientific Literature.

Radium and Cancer.

The Vienna Academy of Sciences recently commissioned Dr. Exner to enquire into the method of curing disease by radium, and he has submitted a report in respect to the treatment of cancer. According to this report, in nine cases radium has effected very considerable abatement in the cancerous swelling, and in two of these cases the swelling has not reappeared, although five months has elapsed since the treatment. In one case, where it was impossible to operate for a cancer in the palate, radium has effected considerable improvement. Dr. Exner concludes, that in cases in which an operation is possible this course is preferable, but the radium treatment is advisable where an operation is impossible.—*Abstracted from Electrician (London), November 6.*

A New Electrolyte for the Wehnelt Interrupter.

When a sulphuric acid solution is used as the electrolyte for the Wehnelt interrupter, there are two drawbacks—first, a relatively high voltage is required for operation; second, a comparatively high current, varying according to the value of the voltage, must be used. The first difficulty has been partly overcome by Carpentier, by increasing the conductivity of the electrolyte. The second difficulty is partially avoided by increasing the resistance of the interrupter and by diminishing the surface of the platinum point, so as to have the latter reach an incandescent state at a lower current. To improve the interrupter, Mr. D. E. Hauser has sought for a new electrolyte, and he has found that that best meeting the conditions is a half-saturated solution of magnesium sulphate, slightly acidulated with sulphuric acid. This electrolyte, though exhibiting a considerable conductivity, is not corrosive, and permits the operation to be started at a lower voltage. It also gives rise to an increased number of interruptions of the current. Mr. D. E Hauser found that this solution worked well with voltages as high as 118; but, by adding to a solution of sulphuric acid of the specific gravity of 1.05, twenty per cent of magnesium sulphate, the interrupter started at twenty volts, with a consumption of only five amperes. With sulphuric acid alone the best results at a voltage of twenty were obtained with a specific gravity of 1.305, fifteen amperes flowing.—*Abstracted from the Electrical Engineer (London), November 6.*

Relative Cost of Public Lighting by Gas and Electricity.

In a report prepared by Mr. J. W. Bradley, for the council of the city of Westminster, comparative costs are given for street lighting by gas and electricity. This city is lighted by electric arcs, and by gas burned in ordinary flat-flame burners, in single burners with incandescent mantles, in lamps having four burners grouped together with incandescent mantles, and in Sugg high-pressure lamps with incandescent mantles. All the lamps burn about 3,900 hours per annum. The candle-power of the electric arcs is about 570. For flat-flame gas burners, and for those with single incandescent mantles, the candle-power is about fifty. For the lamps with four-grouped burners, the candle-power is 113, and for the Sugg high-pressure lamps it is 481. The total cost per electric arc per year varies from $110 to $170, according to the location of the lamps. The average total cost per candle-power per year for these lamps varies from seventeen to thirty cents. For the ordinary flat-flame gas burners of from forty-eight to fifty-eight candle-power, the total cost per lamp per annum varies from $30 to $47.70. The average cost per candle-power per year varies from fifty cents for the fifty-eight-candle-power to ninety-five cents for the forty-eight-candle-power burners. For the single-burner incandescent mantle the cost varies from $14.45 to $17.50. The average total cost per candle-power per year is about thirty-seven cents. For the lamps with four incandescent mantles the total cost per annum is $66.60. The average cost per candle-power per year is about sixty-two cents. For the Sugg high-pressure lamps, the total cost per year is $91.25, and the average cost per candle-power per year is twenty-one cents.—*Abstracted from Engineering (London), November 6.*

Electrolytic Preparation of Metallic Powders.

If an electrolyte composed of a metallic compound be electrolyzed with a mercury cathode, a corresponding amalgam is obtained, and this may be done in the case of metals which ordinarily do not form amalgams. This furnishes a convenient method of preparing metallic powders, and has been used for this purpose by M. A. Zamboni. The amalgam is prepared as indicated above, the excess mercury is pressed out and is then heated to distill off the mercury. The metal remaining behind can then easily be reduced to a fine powder, and in consequence of the treatment is in a pure condition. The method is suitable for preparing powders for the Edison storage battery.—*Translated and abstracted from L'Electricien (Paris), November 7.*

Radium and Plants.

With a view of obtaining information regarding the sensibility of protoplasm toward the radiations of radium, Mr. Henry H. Dixon distributed 100 cress seeds uniformly over the surface of some sand contained in a saucer. Then a tube containing five milligrammes of pure radium bromide was supported at a height of one centimetre over the centre of the sand. During the experiment the saucer was covered with a glass shade and was kept in the dark. After two days, germination took place nearly simultaneously all over the sand, the growth of all the seedlings being nearly uniform; but a close comparison showed that the seedlings immediately under the radium tube were retarded in their development to some extent. This retardation was apparent in the seedlings situated within a radius of about two centimetres of the radium bromide. Besides being smaller, they developed fewer and shorter hair roots than those nearer the margin of the sand. The subsequent growth of the plants seemed to be in no way affected by the radium, nor did it appear to exercise any noxious effects, other than the retardation just described. The experiment was repeated twice with the same results. To determine if motile organisms are sensitive to the radiations, Mr. Dixon enclosed the radium in a tube of water containing large quantities of volvox globator. Extraneous light was cut off during the experiment. After twenty hours many of the volvox colonies had sunk to the bottom of the vessel, but they were evenly distributed over the bottom, while those that were still swimming in the water were also uniformly distributed through it, some being in contact with the radium tube. None showed signs of being attracted to or repelled from it. These experiments indicate that the radiations emitted by radium bromide are not able to produce marked effects in a short time on these vegetable cells and tissues. —*Abstracted from Nature (London), November 5.*

Photometric Tests of the Chemical Brightness of Burning Magnesium and Phosphorus.

Bunsen and Roscoe have said that the burning of magnesium gives a simple and safe method of making photometric measurements. Herr J. M. Eder has found that magnesium light may also be put to other uses. The optical brightness of magnesium, burning in air, of which 7.4 milligrammes burn in one second, is 135 candles. The chemical brightness with free action upon silver bromide plates for one milligramme of magnesium is 435 second-metre-candle; for one milligramme of magnesium, acting on silver chloride, it is 872 second-metre-candles. Aluminum in sheet form, burned in air, gives, for one milligramme, a chemical effect on silver bromide of fourteen second-metre-candles; while the same material, burned in oxygen, gives from 715 to 824. Phosphorus, in comparison with magnesium and aluminum, as a source of light for chemical action, is of little value.—*Translated and abstracted from the Journal für Gasbeleuchtung und Wasserversorgung (Munich), November 7.*

Acceleration of Steam Locomotives.

In a technical study of train acceleration made recently by Messrs. D. W. D'Alton and John Manheim, London, the opinion is expressed that the eighty or 100-ton locomotive will not give the acceleration required for handling suburban traffic. Even leaving the great questions of economy, life of permanent way, and impracticability as a consequence of huge dimensions and weight out of the question, they reach the conclusion that the locomotive engineer, although he may overcome all his difficulties and construct a boiler—perhaps a water-tube one—which will keep steady steam, and increase its weight almost to the point at which the engineer responsible for permanent way will protest, he will find that his engine will require more than double the energy which the electric train asks for. This comparison is made only at a speed limit of twenty-two miles per hour, and stations one mile apart. These are the conditions which must be met, if the competition of the electric tramways in the vicinity of large cities is to be broken down.—*Abstracted from the Railway News (London), November 7.*

The Capacity of a Geissler Tube in a Magnetic Field.

The variations in the capacity of a Geissler tube, caused by a magnetic field, have been studied by Herren E. Lapuchin and A. Afanasieff. Three series of experiments were carried out: first, without the magnetic field; one in which the tube lay parallel to, and the other in which the tube lay at right angles to the lines of force. They find that when the tube is not in a magnetic field the capacity is constant so long as there is no illumination of the tube. The capacity in this case appears to be that of the electrodes alone. This condition holds for air pressures from one atmosphere to fifty millimetres. At lower pressures illumination appears, and the capacity increases rapidly. It reaches its maximum at a pressure of one millimetre. By further exhaustion, to pressure of 0.07 millimetre the capacity diminishes. From 0.07 millimetre to 0.03 millimetre pressure there is a sudden decrease in the capacity. When the magnetic field is parallel to the tube it has no marked effect upon the capacity, so long as the pressure in the tube is greater than one millimetre and there is no illumination. As the pressure is decreased from one millimetre, the effect of the field becomes marked, the capacity of the tube diminishes. At the same time the illumination is distorted, and is split into two rays. When the pressure on the tube has been reduced to 0.07 millimetre, the effect of the magnetic field decreases, and at a pressure of 0.03 millimetre the capacity is not much greater than that of the electrode. When the tube is perpendicular to the magnetic field, the effect of the magnetic field appears much sooner, the illumination is distorted, and the capacity increases, the maximum increase appearing with a pressure of five millimetres. With further exhaustion, the effect of the field decreases until, after a pressure of 0.05 millimetre, the capacity is not increased by the field. With still further exhaustion, the field decreases the capacity of the tube, the action being analogous to that of tube parallel to the field.—*Translated and abstracted from the Physikalische Zeitschrift (Leipsic), November 1.*

Seeing at a Distance by Electricity.

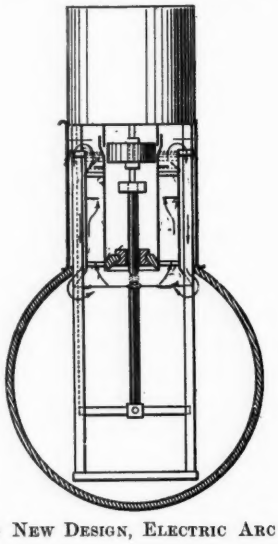
The various methods which have been proposed from time to time for transmitting sight electrically have been studied by M. A. Nisco, but they seem to him to lack certain necessary features. He has therefore devised the following system, which he believes to be practical. A sensitive screen is prepared by coating a metallic net with some insulating gum. Into the meshes of this net copper wires are inserted before the insulation hardens. After drying, the surface is dressed off with a file, and is then coated with selenium, thus forming a sensitive connection between the wires and the net. The screen prepared in this way is treated to crystallize the selenium, so as to bring it into the proper sensitive condition. The copper wires which terminate in the screen are then led into an ebonite cylinder, and pass out through holes corresponding in position to their termination in the sensitive screen. These holes are arranged in spirals in such a way that a metallic blade which revolves around the cylinder successively makes contact with every terminal. The blade is revolved about the cylinder at a speed of 600 revolutions per minute, so that every contact is repeated ten times a second. From the blade and from the wire net of the sensitive screen, wires are led through a battery and to a telephone receiver. If a picture be thrown upon the sensitive screen, and the blade be revolved about the cylinder, a varying current will be sent through the telephone, the intensity of which will vary with each contact, according to the intensity of the light falling upon the corresponding section of the screen. This telephone by means of a sensitive carbon microphone, repeats through the transmission line the current variations produced by the apparatus just described. At the receiving station a second telephone repeats the variations in current through a second microphone in a local circuit arranged to produce a spark. The intensity of the spark at any instant corresponds to the intensity of illumination of a particular part of the selenium screen. This spark-gap is placed within a cylinder having spiral slots, and the slotted cylinder revolves in synchronism with the contact blade at the transmitting station. This arrangement throws the light of each spark on such a part of a receiving screen so as to produce an illuminated image similar to that thrown on the sensitive receiving screen. The method can only produce variations in illumination. It requires two wires, one for synchronizing the moving parts, and one for transmitting the varying current.—*Translated and abstracted from Electro (Brussels), October.*

Transactions of the American Electrochemical Society.

Volume iv of the transactions of the American Electrochemical Society contains the papers and discussions of the fourth general meeting, held at Niagara Falls, N. Y., September 17 to 19, inclusive. This volume is now being distributed.

Electrical Patents.

Mr. Andre Blondel, a Frenchman, residing in Paris, France, has patented in this country a new type of arc lamp. The feature of this lamp he describes as follows: The invention has relation to an electric arc lamp of the type or class where in one or both of the carbons is or are combined with light-producing salts; and in such connection it relates to the construction and arrangement of the parts of the lamp whereby the composite carbons can be economically and advantageously employed. Heretofore it was known that the luminosity of highly incandescent carbons could be increased if the carbon is mixed with salts of lime, magnesia or similar minerals. However, in the use of such carbons it has been found that certain disadvantages due to the nature of the carbon were present—namely, the production of melted scoria, the diffusion of vapors and smoke, and the unsteadiness of the light. The principal objects of the invention are, first, to provide in an electric arc lamp two vertically arranged carbons, one, the lower and positive carbon, being mixed with the light-producing salts, and the upper electrode, either of carbon combined with a small percentage of these salts or of pure carbon provided with a refractory shield or plate encircling the carbon above the arc formed between the carbons; second, to provide an electric arc lamp with a smoke-consumer or draft passage, in addition to the two carbons and the refractory shield or plate upon one of said carbons; third, to provide an electric arc lamp, wherein a composite carbon is opposed to a substantially pure carbon, a combined means for preventing the accumulation of scoria upon the carbon and the diffusion of smoke and vapors about the luminous centre of the lamp, as well as for securing an increase in the luminosity of the arc by refraction. The lower carbon is preferably the positive electrode when in a continuous-current lamp, and as such it consists of carbon mixed with the light-producing salts either in block or having a core of such composite carbon surrounded by pure carbon. This lower carbon in an alternating current is the alternative electrode. The upper carbon is preferably the negative electrode of a continuous-current lamp, and as such it is essentially of pure carbon with a slight percentage of the light-producing salts either in block or in its core. It may, if desired, be formed of pure carbon with a composite covering. In alternating-current lamps this carbon is an alternative electrode. Upon this upper or negative carbon is arranged a shield or plate of refractory material or metal. This shield or plate may be of any preferred form, so long as it accomplishes the twofold purpose or function of protecting the upper carbon from vapors arising from the arc by condensing said vapors of its under surface, as well as reflecting the light from above the arc downward from that surface upon which the vapors are condensed. A number of advantages are claimed with the above described arrangement, some of which follow: "By placing the composite positive carbon below the upper or negative carbon a curious phenomenon arises. As is well known the luminous mineral vapors have a tendency to rise and separate themselves from the carbon or smoke vapors when the current flows from the upper to the lower carbon. The arc in this instance is luminous only in its upper part, near the upper carbon. When, however, the composite carbon is

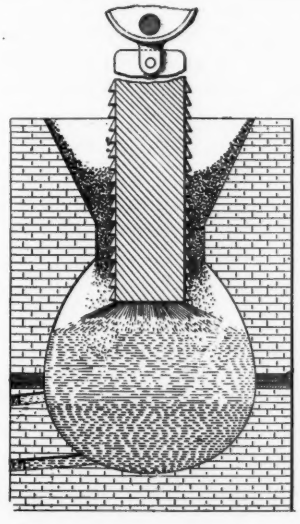


Showing New Design, Electric Arc Lamp.

placed below the upper negative carbon, the ascending current heats the luminous vapors during the whole of their course, and when assisted by the shield or plate this results in an increase of the total luminous flux of from twenty-five to forty per cent in similar lamps and from one hundred to three hundred per cent in other arc lamps. Again, when the composite carbon is placed below, it is no longer licked by the flame, and hence produces less scoria. The scoria produced runs off the carbon without falling into the arc. The upper carbon being substantially pure produces no troublesome globules of scoria. To increase the steadiness of the light, it is preferable in alternating-current lamps to place in both carbons a core containing alkaline salts, such as tartrates, carbonates, etc., of sodium or potassium, etc. The combining of a small percentage of light-producing salts with the carbon of the upper electrode is of little value in continuous-current lamps except perhaps in reducing the consumption of the upper carbon. In alternating-current lamps, however, the combining of each carbon with the light-producing salts assists in increasing the luminosity of the arc. In such instances the lower carbon should contain from thirty to sixty per cent of mineral substance, whereas the upper carbon should contain from but five to twenty per cent of the salts of lime, etc., or a core of large diameter containing a considerable quantity of this substance. In any case the special feature is a composite lower carbon. In addition to this the shield or plate around the upper carbon protects it from the action of the flame, the ordinary function of a shield, and it condenses on its under surface adjacent to the arc a large proportion of the mineral vapors, which form upon the shield or plate a white reflecting coating or layer. Its reflecting surface renders the light uniform by diffusing nearly the same quantity at all times, in all directions."

A novel electric furnace has been patented by Mr. William S. Franklin, of South Bethlehem, Pa., who has made an assignment of one-half interest to Mr. Frederick Conlin, of the same place. The furnace is particularly intended for the reduction of iron ore, though useful for operating upon other substances. A suitable brick structure is provided within the lower portion, in which is formed a pear-shaped chamber, communicating at its upper end with a short cylindrical passage that terminates in a flaring or funnel mouth, by which materials are introduced into the furnace. At a level above the bottom of the lower chamber is located a layer of carbon, metal, or other suitable material constituting a conductor of electricity and preferably in the form of plates built into the structure. This also extends entirely around the chamber and constitutes a part of the wall thereof. The portions of the chamber which are not covered with the carbon and also the passage and the mouth are preferably lined with suitable refractory material. The layer of carbon is connected with a pole of a suitable source of electricity and constitutes one electrode of the furnace. The second electrode is in the form of an ordinary rod or bar of carbon, metal, or other suitable material, which is supported in any suitable manner so that it will hang down in the funnel mouth of the passageway with its lower end located in

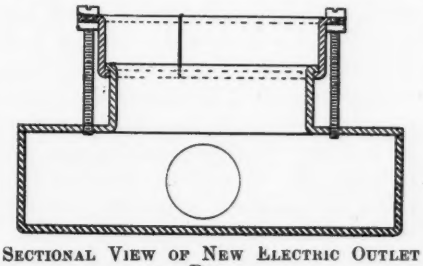
the chamber. This bar is provided on its sides with downwardly inclined teeth. It is adjustably supported by any suitable means, preferably a shaft having a cam about which passes a strap having a lug that is pivoted to the upper end of the bar. Near the bottom of the chamber is located a vent that passes through the walls of the structure and communicates with said chamber, and at a higher level a second vent of a similar form is located. These are normally closed by suitable plugs. In the operation of the furnace, a portion of the chamber is filled with a molten electrical conductor which has a high resistance, such material as slag or glass being suitable for this purpose. The current of electricity is made to pass from the suspended electrode through the molten conductor to the layer of carbon in the walls, consequently the conductor is raised to and maintained at a very high temperature. If the upper electrode is partially immersed in the



NEW TYPE OF ELECTRIC FURNACE.

molten conductor the heat developed will be almost entirely due to the resistance of the same. If, however, the upper electrode is above the upper surface of the molten conductor an arc will be formed between such electrode and the said surface, and the heat of such arc will be added to the heat developed by the resistance of the molten conductor. The material to be acted on by the furnace is introduced into the mouth or funnel and is fed slowly downward by any suitable means, as for instance, by the reciprocation of the electrode, the teeth of which operate upon the material surrounding the same. In its downward passage such material is first subjected to the action of the heat ascending from the molten conductor and afterward comes into contact with the highly heated molten conductor itself. If the upper electrode is raised above the molten conductor the descending material is also directly acted upon by the arc formed between said electrode and such conductor. If the product resulting from the action of the heat or electricity, or both, on the descending material is of greater specific gravity than the molten conductor, such product will pass through said conductor and collect in the bottom of the receptacle. During the passage of the conductor, the product will be separated from impurities of lighter specific gravity than itself, as such impurities will either float on the surface of the molten conductor or will remain in the body thereof. The product then can be drawn from the lower vent, while the molten conductor can be kept at the proper level by means of the upper vent. If such product is of less specific gravity than the molten conductor, the conductor will occupy the bottom portion of the receptacle, while the product will accumulate at the level of the upper vent and can be withdrawn therethrough. In such case, if the product be of greater conductivity than the molten conductor, it is desirable not to have the lower electrode extend above the level of the molten conductor.

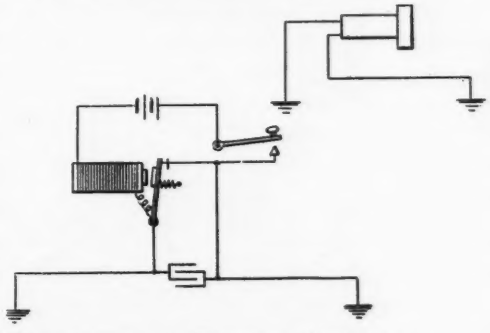
An electrical outlet box, having an adjustable mouth, has been patented by Mr. Hubert Krantz, of New York. The box which is made of any suitable form is provided with a cover having a projecting mouth, sleeve or base, the rim of which is outturned to form an annular flange. An adjustable sleeve embraces the mouth sleeve and has at its inner end an inturned flange that interlocks with the outturned flange of the rim. This limits the outward movement of the adjustable sleeve. This adjustable sleeve is split so that it



SECTIONAL VIEW OF NEW ELECTRIC OUTLET BOX.

may be sprung over the flange rim of the box sleeve and it furthermore has an outturned flange at its free end provided with openings. Adjusting screws pass through these openings, and either bear against or are threaded into the box. By rotating these screws the adjustable sleeve can be moved toward or from the cover and thus the length of the mouth changed as desired.

An invention in systems of electrical communication has been patented in this country by two Englishmen, Messrs. James T. Armstrong and Axel Orling, both residents of London, England. The invention relates to means and apparatus for operating or controlling distant apparatus or mechanisms without the employment of wire or other like connection between the controlling station and the apparatus to be operated or controlled. In carrying out this idea the inventors provide transmitting apparatus with two or more earth connections, through which are conducted a combination of high-potential discharges and low-tension currents whose circuit or circuits are completed through numerous lines of current flow which traverses the earth. The transmitted impulses enter the earth by one of the earth connections and after traversing the same return to complete the circuit through the other. The receiving apparatus is also provided with two or more earth connections which are adapted to cut the lines of current flow at points of



TRANSMITTING AND RECEIVING APPARATUS—WIRELESS TELEGRAPH SYSTEM.

different potential, causing some of the transmitted energy to flow through them and actuate the receiver. Preferably the transmitted discharges take place with great rapidity, while the earth connections are also preferably some distant apart.

Meeting of the Directors of the Hudson River Telephone Company.

On November 19 the directors of the Hudson Telephone Company held a meeting at Albany, N. Y. Mr. James H. Manning tendered his resignation as president of the company, to make way for the election of a practical operating telephone man, Mr. Charles F. Cutler, president of the New York and of the New York & New Jersey Telephone companies. During President Manning's term the company's subscribers increased from 7,000 to nearly 23,000.

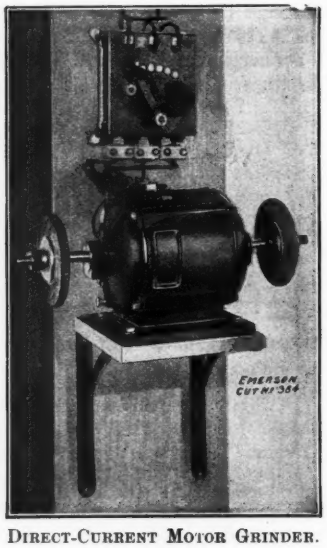
INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

Direct-Current Motor Grinders.

The accompanying engraving shows a simple inexpensive motor grinder with ample power for lathes and planer tools, drills, etc. Two emery wheels, six inches diameter, one-half-inch face, five-eighths-inch bore, are mounted on a grinding spindle which is substituted for the ordinary shaft on a regular type of Emerson direct-circuit motor, made by the Emerson Electric Manufacturing Company, St. Louis, Mo. No tool rests are furnished, as experience indicates that they are unnecessary for a large proportion of the light grinding for which this outfit is designed.

This grinder forms a valuable adjunct to any machine tool where frequent grinding of the cutters is necessary, as the motor may be placed close at hand, on a near-by post, as shown, or on any bench where current is available. Very often it is possible to locate this outfit in a busy part of the shop, where it will conveniently serve a number of tools, and where line shafting is inaccessible, and when mounted on a shelf, the post forms a convenient back for switch, starting box, and fuse-block.



DIRECT-CURRENT MOTOR GRINDER.

The motor is of the Emerson type, designed for one-third horse-power normal load, but with a heavy overload capacity running as high as 100 per cent for a few moments. It is entirely enclosed to prevent injury from dust, dirt, etc., and has removable covers, giving access to the brushes. The bearings of the motor are protected from injury by emery dust by brass caps surrounding the shaft, and are extra heavy and well proportioned for the work. The armature and commutator are of the engine type. The field is built up of mild steel laminations and has six poles with form-wound coils.

This spindle is removable without difficulty, as the armature and commutator are arranged on an interior sleeve in place of being assembled directly on the shaft as is usual in motors of this size. The shaft or spindle may be withdrawn from this sleeve by knocking out one pin, and without disturbing the relation of the armature and commutator.

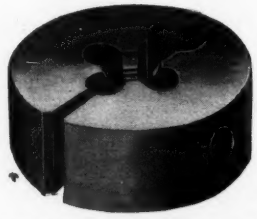
This outfit meets almost all the requirements of light grinding. The outfits are covered by the Emerson Electric Manufacturing Company's guarantee.

Improvement in Automobile Design.

In a report of a committee to the British Association, on the resistance of road vehicles to traction, the progress in automobile design is given as follows: In 1895 Levassor made the run from Paris to Bordeaux in a five-horse-power car weighing about one ton, or one horse-power for 550 pounds dead weight. In 1896 this weight was reduced to 365 pounds per horse-power. In 1900 it fell to ninety pounds per horse-power. In the recent Paris-Madrid race, M. Gobron Brillie used a 100-horse-power car, the weight of which rated only twenty-two pounds per horse-power. This weight has been still further reduced in the case of motor bicycles, reaching as low a figure as 17.5 pounds per horse-power, but there is not a corresponding increase in speed. In 1901 M. Fournier made 53 miles per hour with a twenty-eight-horse-power Mors, and last year M. de Knyff only slightly exceeded 58.5 miles per hour with a seventy-horse-power machine—that is, an additional forty horse-power. The small increase in speed can be attributed partly to low resistance, but not all. An extremely powerful motor must be accompanied by a comparatively heavy load; otherwise, the wheels do not bite well and energy is wasted. The modern racing car skims along the surface of the course, without sufficiently close contact between the wheels and the ground. To overcome this defect, the driving wheels should be more heavily weighted and springs made less elastic.

Adjustable Round Split Dies and Hand Taps.

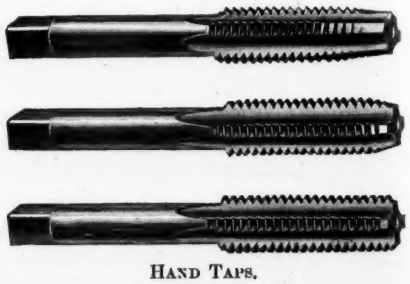
The Smith & Hemenway Company, 296 Broadway, New York city, has added to its line of hardware specialties Bay State taps and dies, manufactured by the Bay State Tap and Die Company, the entire market of which the Smith & Hemenway Company controls. These tools are made of highest grade steel, are well finished, and the manufacturer states have excellent wearing qualities. The workmanship executed by these tools is of a superior nature, and special attention has been paid by the maker to the pitch of the thread, which it is claimed is absolutely correct.



ADJUSTABLE ROUND SPLIT DIE.

United States standard "V" or Whitworth form of thread will be made on any style tap or die. Each tap or die is sold under rigid guarantee, and should any defective tool be found, it will be exchanged for a perfect one.

The Smith & Hemenway Company has the entire marketing of the products of the following companies: Utica Drop Forge and Tool Company, manufacturer of pliers and nippers; Acme Ball Bearing Caster Company, manufacturer of casters and jacks; Bay State Tap and Die Company, manufacturer of taps and dies; Vandegrift Manufacturing Company, manufacturer of wrenches; Page-Storm Company, manufacturer of drop forges; Champion Manufacturing Company, manufacturer of hammers, hatchets and ice picks.



HAND TAPS.

Motor-Driven Fire Pumps.

The Chicago Edison Company recently installed in the basement of Marshall Field & Company's wholesale house, Chicago, a water-proof motor for fire protection, which has attracted considerable attention. The equipment consists of a 100-horse-power General Electric CE motor geared through a single reduction to a Laidlaw-Dunn-Gordon eight and one-half by twelve duplex pump. The motor is shunt wound for 230 volts and is totally enclosed. It has a fan mounted on the armature shaft, inside of the frame, between the armature and pinion end bearing. The purpose of this fan is to ventilate the windings by drawing air through a large wrought-iron pipe, screwed into a flange fastened on the front end of the motor frame. The air passes through the motor and is discharged from a similar opening at the opposite end, thus keeping the field coils and armature at a safe temperature when operating at full load. The electrical conductors to the motor are led in through a pipe screwed into the frame, and the construction is such that a fire stream of water can be played upon the motor or it can be completely submerged in water without injury. The pump operates at sixty revolutions per minute and is connected to a sprinkler system extending to all parts of the buildings. The pressure of the system is maintained at 100 pounds per square inch, by means of a pressure gauge so constructed that when the pressure goes below 100 pounds the needle or hand of the gauge closes an electrical circuit through an automatic controller, thus starting the motor. When the pressure increases to the desired amount the gauge hand closes another circuit through the controller and stops the motor. The motor controller being also water-proof, the basement in which the apparatus is located may become filled with water without shutting down the pump, an advantage which is obvious.

The General Electric Company has also furnished an outfit to the Underwriters' Bureau of Fire Protection Engineers, consisting of a CE, fifty-horse-power, 220-volt, totally enclosed and ventilated motor, direct-connected to a No. 7 Quimby screw pump which has a capacity of 500 gallons per minute at 100 pounds pressure. The motor receives current from an Edison three-wire system and is controlled with an R-15-D rheostatic controller constructed so that the motor can be started on 110 volts and when up to about half speed is thrown on 220 volts by the reverse cylinder, the shunt field being connected permanently on 220 volts. This gives twelve different speeds as follows, which is a great advantage for testing purposes:

	110 Volts.	220 Volts.
Step 1, just turning over	470 R. P. M.	
Step 2, 119 R. P. M.	585 R. P. M.	
Step 3, 230 R. P. M.	695 R. P. M.	
Step 4, 330 R. P. M.	795 R. P. M.	
Step 5, 400 R. P. M.	865 R. P. M.	
Step 6, 435 R. P. M.	900 R. P. M.	

The motor is compound wound with accumulative series winding. The resistance (dimensions twenty inches by twenty inches by twenty-six inches) used for starting is immersed in running water and takes up very little space in comparison to air-cooled resistance. This outfit is installed at the Underwriters' laboratory at 67 East Twenty-first street, Chicago, and is used for testing hose, hose nozzles, sprinkler heads, valves and all apparatus used for fire protection. The Underwriters' Engineers state that the motor has given universal satisfaction and they will be pleased to exhibit it in operation to visitors at any time.

Electrically Driven Pumps for Mine Drainage.

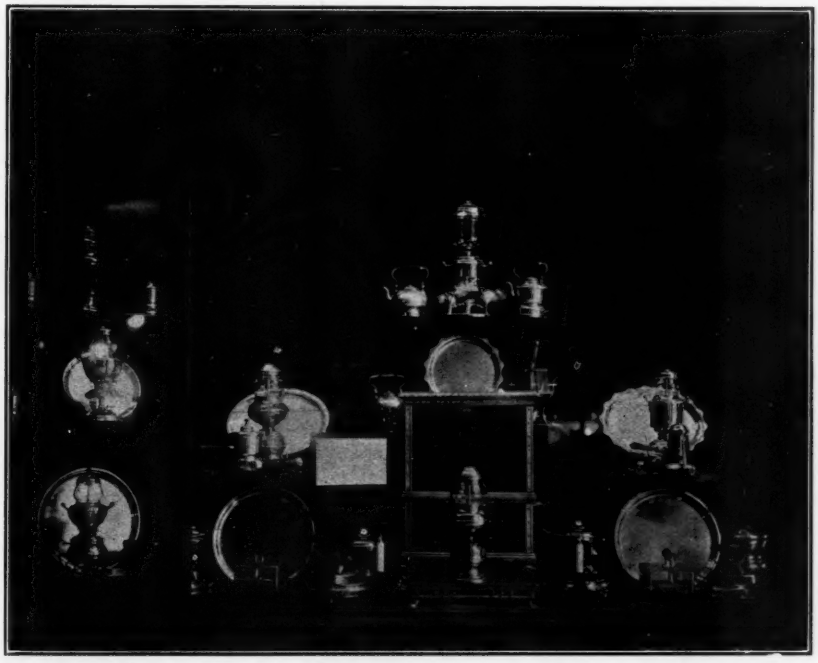
The electrically driven pumps installed for drainage purposes in south Staffordshire are said to be giving excellent results, and it is thought that this method of draining will make possible the recovery of many coal fields in that section of England, which are now lying drowned. It is stated that the substitution of electricity for steam will make a difference of fivepence per ton of coal worked.

A Fine Display of Electric Heating and Cooking Apparatus.

The accompanying illustration shows an interesting display of electric heating and cooking apparatus exhibited in one of the large show-windows of R. H. Macy & Company, of New York city. This apparatus is manufactured by the Prometheus Electric Company, 39 Cortlandt street, New York city.

The apparatus manufactured by this company has been described at length in the ELECTRICAL REVIEW and contains, as is well known, a resistance element which can be readily removed in case this should become necessary.

In addition to the exhibition in the window, the Macy company has an attractive display and demonstration of electric cooking apparatus in the basement of the building. The sales since this crusade has begun have been considerable and entirely up to the expectations of the manufacturer.



A WINDOW DISPLAY OF ELECTRIC HEATING AND COOKING APPARATUS.

A large number of agencies have been established by the Prometheus company throughout the country, all of which are meeting with success. Orders have recently been received for the entire heating equipment contract for the factory of F. Berg & Company, hat manufacturers, of Orange Valley, N. Y., as well as the heating equipment of two large ships now building in New London, Ct., for the Great Northern Company.

A number of new industrial appliances have been perfected recently, such as cigar box branders, paste heaters and heaters for all machinery. All of these have been highly successful on account of the ease with which the elements can be applied to the machinery and the high efficiency of this method of application.

An Electro-Visual Thermo-Gage.

In various industries accurate means are provided for measuring the different properties of the various materials which enter into the construction of the vast outputs. Lengths are measured with the greatest accuracy by the aid of a delicate micrometer, weights by scales of various degrees of delicacy, densities by hydrometers, and the composition of various materials by mechanical analysis, etc.; but while the lower temperatures are read by the aid of mercurial thermometers, the higher temperatures seem to have been left to guess at, or measured by the observation of skilled operators. These operators determine the temperature by the color or degree of incandescence of the materials being heated. The Morse Thermo-Gage Company, Trumansburg, N. Y., has placed on the market a pyrometer, by means of which high temperatures can be accurately determined. This thermo-gage is based on a comparison of color and degrees of incandescence and is covered by seven United States patents which are as follows: April 1, 1902, No. 696,878; April 1, 1902, No. 696,916; March 17, 1903, No. 722,770; August 4, 1903, No. 735,361; August 4, 1903, No. 735,423; August 4, No. 735,424; August 4, 1903, No. 735,525.

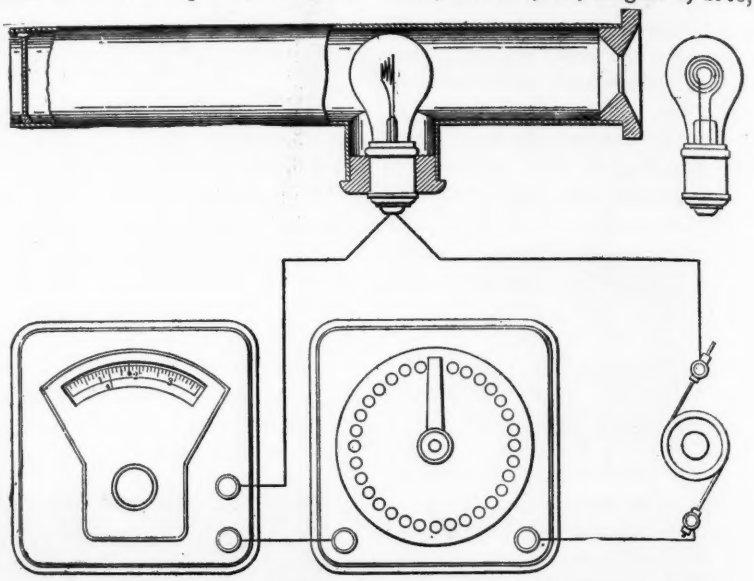


FIG. 1.—DIAGRAMMATIC ILLUSTRATION, SHOWING MORSE THERMO-GAGE.

The instrument is diagrammatically illustrated in Fig. 1, and consists of a lantern tube, incandescent lamp, rheostat and an ammeter. The incandescent lamp contains a specially designed filament and is placed in the lantern tube as shown in the illustration. If it is desired to measure the temperature of any substance being heated, the substance is viewed through the lantern tube and the coiled filament. Then the temperature, and consequently the color of the filament are raised, by adjusting the rheostat, until it merges into the color of the substance. When the heating has reached this point, the filament and the heated substance will be at the same temperature. This temperature can then be determined by means of the ammeter and a table of constants which accompanies each instrument. If, on the other hand, it is desired to heat the substance to a certain temperature, the rheostat is regulated until the ammeter indicates the desired temperature; the substance is then heated and viewed through the lantern tube until it has reached the same degree of heating as the filament. When this point is reached, the substance is at the required temperature.

Fig. 2 shows the instrument arranged for regulating the temperature of a lead bath, and Fig. 3 shows it in use in connection with a heating furnace.

Fig. 4 shows the instrument as arranged for the direct inspection of tools when heated in a blacksmith's forge. The end of the tube is covered by a hood to ex-

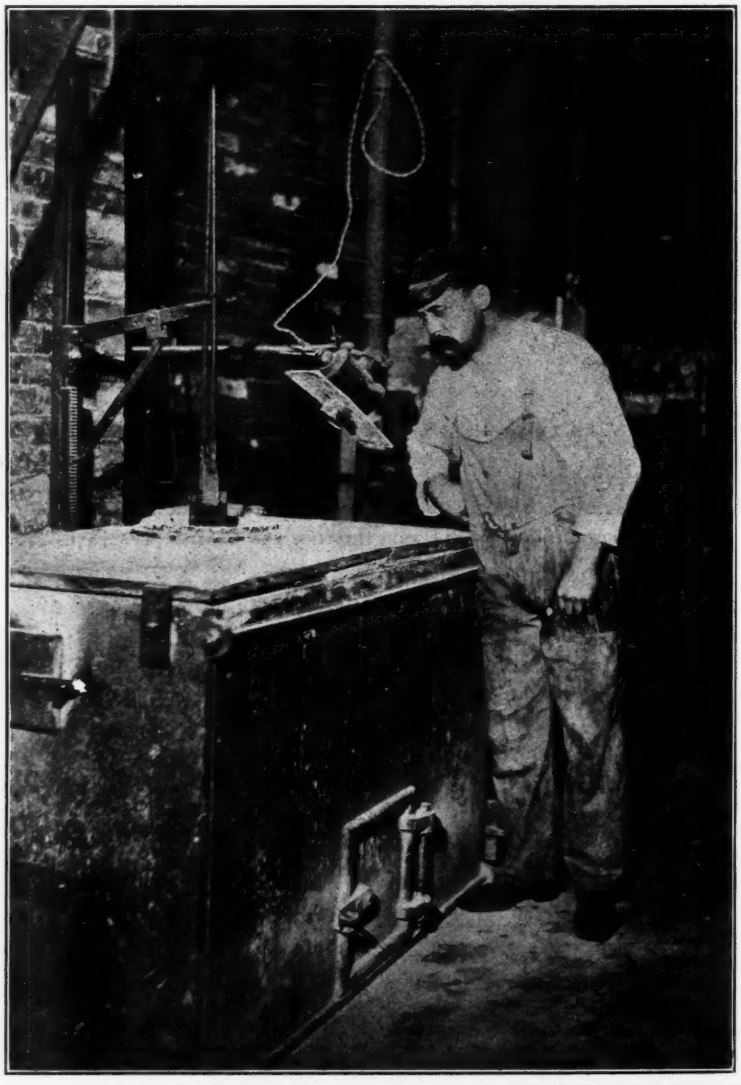


FIG. 2.—HEAT GAGE AS USED WITH A LEAD BATH.

clude all outside source of light, the hood having an opening on one side into which the tool is inserted.

The manufacturer claims that a variation in temperature to five degrees Fahrenheit either side of that of the filament may be detected, while by using a magnifying glass this is reduced to one degree. Every steelworker is aware of the fact that high carbon steel is far more sensitive to heat than is low carbon steel, and there is no doubt that this fact has greatly restricted its use. The zone of hardening temperature for high carbon steel is, in fact, so narrow that it can not. The same hardener does not always confine himself to it and there is no doubt that with different hardeners the variation in hardening temperature has often nullified the superior qualities of the steel.

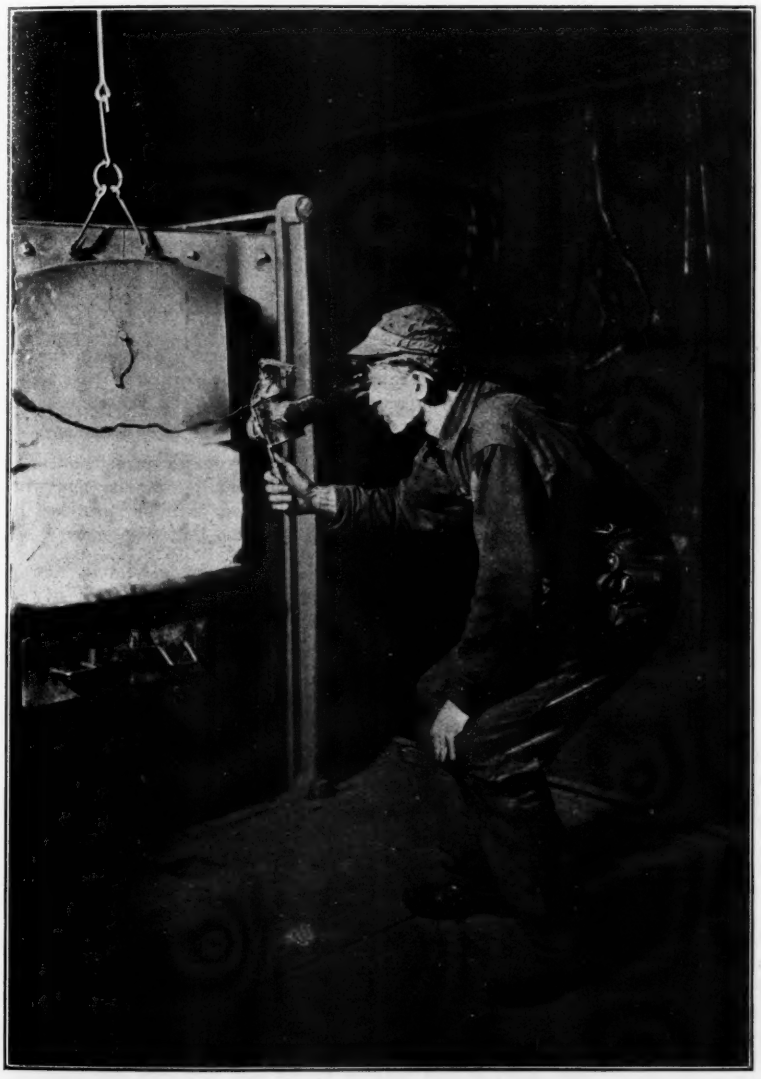


FIG. 3.—HEAT GAGE AS USED WITH A HEATING FURNACE.

There is not found any deterioration of the filament, because the temperature at which steel is hardened is much lower than that to which the ordinary incandescent lamp filament is subjected. The latter is a glowing white heat, while the former is a "cherry red" or lower. At these temperatures the filaments are not found to deteriorate appreciably, one of them having been in constant use for the past three years. The readings of the ammeter are in all cases standardized in order that different instruments may give the same results. The graduations may be made to indicate the degrees of temperatures directly or they may be arbitrary marks for different brands of steel and different classes of work.

World's Fair Bulletin.

The *World's Fair Bulletin* for November, published by the World's Fair Publishing Company, contains a great deal of interesting information and many fine half-tones. This bulletin keeps the reader informed of the progress of the work on the different buildings, and also shows in half-tone the appearance of the work. Illustrations of the north side of the Machinery Building and the west front of the Manufacturers Building make it appear that there is little more to do to make these complete. A full list of the departments and subjects to be undertaken by the Congress of Arts and Sciences, together with the appointments to the different departments, is given. This list includes the foremost scientists of Germany, Switzerland, Austria, Russia, Great Britain and others.

FIG. 4.—HEAT GAGE AS USED WITH A BLACKSMITH'S FORGE.

An Incandescent Lamp Meter.

The Talmont Electric Engineering Company, 150 Nassau street, New York city, has placed on the market an incandescent lamp meter. This consists of an amperemeter built in between the plug and the lamp socket. The dial is marked off to read from zero to 1.5 amperes. The instrument can be used for either direct current or alternating current. The range of the meter is from eight to thirty-two candle-power at 64 to 220 volts alternating current, forty to fifty cycles, and it is fitted with either Edison or Swan sockets.

To operate, the meter is screwed into the lamp socket, and the lamp is attached to the meter, as shown in the illustration. Current is then turned on, and the needle on the dial will indicate the consumption of current.

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

CANADIAN TELEPHONE PROPOSITION—The organization of the Canadian Telephone and Telegraph Company, with headquarters at Ottawa, has been completed. The company has been chartered at a recent session of the Dominion Parliament, and has made a deposit of $25,000 with the government, as required by the act of incorporation. Another requirement, that $100,000 of stock be subscribed, has also been met. The total capital is $1,000,000. If the company can get the franchise from Ottawa council, it will begin the construction and installation of its system at once. The company is empowered to build trunk lines, and the ultimate expectation is to stretch the system across the continent.

EXTENSIVE NEW ZEALAND TRACTION SYSTEM—An extensive electric traction system is to be constructed at Christchurch, New Zealand. There will be thirty-six miles of single track, including two and one-half miles of double track. Contracts will be let after March 17 for the power-house equipment, steam plant equipment, steel stack, traveling crane, cooling tower, car bodies, car trucks, car motors, compressed-air brakes, equipment of cars and sundry supplies, together with road-bed and auxiliary apparatus, including the overhead construction. Copies of the drawings, specifications and schedules may be had by the middle of December, on application at the office of the general agent for New Zealand, Victoria street, London. The engineer in charge of the proposition is F. H. Chamberlain.

PROPOSITION FOR MUNICIPALLY OPERATED TRACTION IN NEW YORK CITY—It is stated that municipal officials are considering a project to establish an electric car line service over the Williamsburgh bridge, to run from terminal to terminal, and to have no connection or relation with any transit system running to either the Brooklyn or the Manhattan side of the bridge. By this means the officials believe the bridge transit problem may be solved, in view of the alleged refusal so far of the Brooklyn Rapid Transit, the Interborough and the Interurban companies to make any proposition looking to a transit system over the bridge or connecting with it. The plan has not taken any absolute form, but the general scheme includes the building of a power-house, the laying of trolley tracks, and the running of bridge cars by either the overhead trolley or the third-rail system.

NEW WESTERN POWER PLANT—It is announced that the McCloud River Electrical Power Company, of Shasta County, California, has completed arrangements for securing the necessary funds for installing its plant for developing the power of the Shasta river. The company plans to supply Oakland and San Francisco with electric power, and will transmit 20,000 horse-power a distance of 275 miles. Light and power will also be supplied to the near-by towns along the way and to several of the largest mining companies in California. It is said that the company will expend $2,000,000 on the plant. The dam and power-house will cost some $850,000; the hydraulic and electrical equipment, $420,000, and the poles and lines, $275,000. James D. Schuyler, of San Francisco and Los Angeles, is the engineer in charge. The power plant will be located sixteen miles from Baird Spur, on the Oregon division of the Southern Pacific.

WATER POWER LITIGATION IN WASHINGTON ENDED—After a long fight for control of the White river water power, a decision has been made by the Superior Court, in favor of the White River Power Company, owned by the estate of William T. Baker, of Chicago. The company has spent $250,000 in developing the work, and will push to completion a plant to generate 50,000 horse-power. The same interests own the Snoqualmie Falls power plant, now supplying Tacoma and Seattle, Wash. Another company, which owns the street railways of Tacoma and Seattle and the connecting interurban line, is constructing a $2,000,000 plant on Puyallup river, near Tacoma. This company also sought to obtain control of the White river power rights. The companies together will supply Tacoma with electric power. The possibility of diverting the waters of White river and dropping them over 800 feet was discovered about eight years ago by Mr. Edwin McHenry, now chief engineer of the Canadian Pacific Railway.

ELECTRIC LIGHTING.

COLUMBUS, OHIO—The Mt. Victory Electric Light Company, of Mt. Victory, has been incorporated with a capital of $10,000.

ESSEX, IOWA—Farris and Eastman, of Clarinda, propose an electric light plant for Essex.

GLENWOOD, IOWA—The electric light power-house was damaged by fire, the machinery being severely damaged.

LOUISVILLE, KY.—The new electric light plant at Jackson has been completed, and the city is now lighted throughout by electric lamps.

TRIBES HILL, N. Y.—The Edison Light and Power Company of Amsterdam is preparing to furnish electric lights for this place and Fort Hunter.

HARRISBURG, PA.—The council has awarded the contract for eighty-five street lights to the Steelton Light, Heat and Power Company, at its bid of $53 per light per annum for five years.

SIOUX FALLS, S. D.—The electric light company has installed a large new dynamo at the Cascade plant. It is an alternating-current machine with a capacity of 2,300 volts, or enough for 3,000 incandescent lights.

NEWTON, N. J.—Ground has been broken for the new electric light plant. Assurance having been received that the equipment will be shipped at the date heretofore set and the company hopes to rush the work for its reception.

ST. PAUL, MINN.—The Columbia Power Company, of Minneapolis, has been incorporated with a capital of $1,000,000. William S. Herber, S. Edward Woodbury and Fred W. Bates, all of Minneapolis, are the incorporators.

NEW YORK, N. Y.—Plans have been filed with the Bureau of Buildings in Manhattan for a four-story and basement brick power-house to be erected by the New York Edison Company, to cost $85,000.

JERSEY CITY, N. J.—The North Jersey Street Railway Company has bought another tract of land in this city and will erect a power-house to cost $350,000. Power will be furnished for the whole trolley system on this side of the Hackensack river.

NEW BRUNSWICK, N. J.—At a meeting held in Newark the Central Electric Company, which supplies light and power to a dozen towns near its main plant in Metuchen, was purchased by the Public Service Corporation of New Jersey.

EAST GREENWICH, R. I.—A five-year contract has been made by the city with the East Greenwich Electric Company. The company is to provide thirty-seven arc lamps for $2,000 per year, and also a number of incandescent lights at $13.20 per light per year.

BILOXI, MISS.—A deal has been closed whereby the Biloxi Electric Light Company has passed into the control of the Biloxi Electric Street Railway and Power Company. The consideration was $29,500 in cash and $18,000 in stock.

ALBANY, N. Y.—F. Y. Lyon, H. A. Bradley and Benjamin Patterson, all of the city of New York, have capitalized the Bradley Universal Heat, Light and Power Company with a capital of $100,000.

VISALA, CAL.—The permit for the construction of a new power plant on the Tule river has been granted by the secretary of the interior, and work on construction will begin at once. It is said that there is now nothing in the way and that the enterprise will be pushed to completion with all possible speed.

BOSTON, MASS.—The Lynn Gas and Electric Company has decided to place all its electrical wires underground in Lynn and the adjacent towns where lighting is supplied and has asked permission to construct underground conduits in the city. The com-

pany plans to first remove all its overhead wires in the centre and closely settled portions of the city.

ST. CHARLES, MINN.—At the first annual meeting of the stockholders of the St. Charles Electric Light Company, the following directors were chosen for the ensuing year: A. B. Dyar, Acil Hendee, Charles Knapp, George Miller and Charles Rabbin. The directors chose the following officers: Acil Hendee, president; Charles Rabbin, vice-president; Charles Knapp, secretary and treasurer.

FAIRFIELD, ME.—The power-house of the Waterville & Fairfield Electric Railway and Light Company, used for the incandescent system of lighting, has been destroyed by fire. The loss to the machinery was about $6,000, covered by insurance. Loss to the building was slight.

BATAVIA, N. Y.—The Consolidated Gas and Electric Company at a meeting of the stockholders voted to increase its capital stock from $200,000 to $300,000. Among the stockholders present were G. D. Miller, of Rochester; C. D. Lawton, of Boston, and Richard C. Garhart, of New York. The increased capital is to be used in the extension of the large plant which is at present under course of construction.

ROSLYN, L. I.—The Nassau Electric Light and Power Company, of Roslyn, has been granted permission by the Hempstead town highway commissioners to erect poles and string wires on all town roads in the town of Hempstead, the privilege being subject in all cases to the consent of abutting property owners. The company is to give a bond of $5,000 for the protection of the town against damages arising by reason of the franchise being granted.

NEWBURGH, N. Y.—The Hillburn Electric Light Company is negotiating for right of way through the Ramapo valley to set poles and string wires for the purpose of supplying the villages of Monroe, Central Valley and the intermediate places with electric lights. Measurements have been taken over the proposed route from Hillburn to Monroe. The company may extend the line on to Highland Mills, also to Hillcrest Hall, the Summit Lake and Mountain Top hotels.

LITTLE ROCK, ARK.—The Fordyce Light and Water Company, of Fordyce, has been chartered by the secretary of state. The capital stock is $20,000, and the officers are B. H. Wood, president and treasurer, and J. G. Pattillo, vice-president. The other incorporators are C. B. Hickey, W. R. Ramsey, John M. Covey, G. M. Hampton, A. B. Banks, J. E. Hampton, Jr., T. M. Rowland, L Amis, E. R. Thomas, R. Finley, G. G. Gatling, E. A. Acruman, G. W. Smith, E. H. Stover, W. J. Proctor, G. N. Richardson and others.

COLUMBUS, OHIO—The board of public service has submitted to City Solicitor Butler the detailed estimate for the construction of the lines of the new municipal electric light plant. The estimate covers the erection of the trunk lines and provides for several minor features of the plant. The estimate is for $60,000, and the money is in the hands of the city treasurer ready for certification by the auditor. The members of the board give it as their opinion that the plant will be ready for operation, furnishing 1,900 city lights, by the first of March.

COLUMBUS, IND.—The city council has decided to install a new electric light plant, the one now in service having become practically worn out and obsolete. The new plant will be of sufficient capacity to furnish light for a much larger city than Columbus, with the purpose of furnishing lights for an extended period of years, and meeting the requirements of a growing municipality. Besides furnishing lights for street lighting purposes, the City Hall, fire department headquarters and waterworks will be lighted, and there is some talk of the city going into commercial lighting, but the latter proposition is not meeting with general favor.

ROSLYN, L. I.—The Nassau Light and Power Company, formerly the Roslyn Light and Power Company, will move its plant, at present located on the line of the Oyster Bay branch of the Long Island Railroad a mile south of this village, to Glenwood. While the transfer will not be made until spring, work upon the new buildings will begin at once, and it is said they will have a capacity not exceeded by any electrical plant on Long Island and not excepting those in the Borough of Brooklyn. The tract purchased by the company comprises nine acres, upon which a power-house will be erected, with a capacity for machinery which will be capable of generating electricity for supplying all of Nassau County. It is expected to have the plant completed and the removal of the present plant to Glenwood before next spring. The Nassau company expects to realize several benefits from the change of location of its principal plant, one of the most important of which will be the reduction in freight rates, the one item of coal alone will amount to considerable within a year's time. The new plant will also be more central, the company now having considerable business in the town of Oyster Bay, including several street lighting contracts.

TELEPHONE AND TELEGRAPH.

WEST FRANKLIN, PA.—The LeFrank Telephone Company will build a line from LeRoy to Franklin.

NASHVILLE, TENN.—A charter has been granted to the Huntland Telephone Company with a capital of $1,000.

WEBSTER CITY, IOWA—The Martin Telephone Company has purchased and consolidated the Chamberlain toll lines, which operate in Hamilton, Boone and Webster counties.

AUGUSTA, ME.—The Bethel Local Telephone and Telegraph Company has been incorporated with a capital of $5,000. F. L. Edwards and D. R. Smith are the incorporators.

LOUISVILLE, KY.—The Oldham Telephone Company, of Oldham County, has been organized with a capital of $10,000. Joseph Sauer, R. B. Blakemore and R. B. Cassady are the chief incorporators.

NASHVILLE, ILL.—At a meeting of the city council a franchise was granted to the Rixman Telephone Company, of Irvington, to operate a telephone system in this city and to establish a toll station. The line of the company has been completed to the city limits.

CONNELLSVILLE, PA.—The Tri-State Telephone Company has opened its new lines to Waynesburg, Greene County, and now has connections with Fairmont and Wheeling and all intervening towns. The company has started the building of its new line to Pittsburg.

GREENSBURG, IND.—The Decatur County Independent Telephone Company has absorbed the Westport & Sardinia Telephone Company, and will operate that line through the local exchange. The new arrangement will give access to the southern part of the county.

DEADWOOD, S. D.—A new franchise has been granted the Nebraska Telephone Company by the council of Deadwood. It gives the company the right to erect its poles and wires and lay subways throughout the principal streets of Deadwood. It is announced by the company that it is prepared to expend upwards of $30,000 on its plant and system in Deadwood.

CROOKESVILLE, OHIO—The Crookesville Telephone Company has been organized with a capital of $10,000, by J. B. Rhodes, J. C. Moore and Thomas F. Wilson, Will Harris and S. M. Winn, for the purpose of establishing an exchange as an adjunct to the Zanesville Telephone and Telegraph Company, with United States and Independent connections with all points that these lines reach.

LITTLE ROCK, ARK.—The Ozark & Cecil Telephone Company has been chartered by the secretary of state. The capital stock is $5,000, and the officers are: William Jones, president; W. G. Stockton, vice-president, and J. C. Wiggins, secretary and treasurer. The other incorporators are J. F. Andrews, J. Bumpers, R. C. Bumpers, S. T. Bumpers, John E. Bryan, W. Carnaham, W. P. Evans, G. W. Ford and others.

AUTOMOBILE NOTE.

GORDON-BENNETT CUP RACE—The Gordon-Bennett cup race will be held in Germany, in the summer of 1904. The Automobile Club of America announces that as the driver of an American automobile in this race must be a member of the club, this opportunity is given of sending in applications. The American team will consist of not more than three. It is further announced that the committee will receive entries until the fifteenth of December, 1903. All entries must be accompanied by a description of the automobile, also a check for $600, which will be refunded as soon as the team has been definitely selected, in case the sender is not chosen.

ELECTRIC RAILWAYS.

TRENTON, TENN.—A company under the name of the Gibson County Construction Company has been organized for the purpose of constructing an electric railway from Trenton to Eaton, Brazil and Gibson Wells.

ANDERSON, IND.—The council has granted a fifty-year franchise to Wallace B. Campbel for an interurban electric railway into or through this city, the road to be in operation by July, 1905. The proposed road will connect Anderson, Noblesville and Lebanon.

WILMINGTON, DEL.—The Delaware Suburban Railway Company, which will construct a line from this city to Newark, a distance of twelve miles, and there connect with other lines which are to be constructed, expects to have the line to Newark completed by May next.

DETROIT, MICH.—The Michigan Central Traction Company has been organized here with a capital of $1,500,000, of which $250,000 is paid up. The company will run limited trains between Detroit, Pontiac, Durand, Lansing, Grand Ledge, Grand Rapids, Battle Creek, Kalamazoo and Niles.

SHARON, PA.—Farmers in this section of the state have formed a mutual company to obtain right of way, and will build a trolley line from Sharon to New Castle by way of New Wilmington. Pittsburg capitalists have promised to aid in the enterprise. The line will enable the farmers to market their grain without making long hauls as heretofore.

MERIDAN, CT.—A syndicate of New York capitalists, represented by Francis Atwater, has purchased the franchise of the Watertown & Litchfield Tramway Company. The company owns a charter to construct a trolley line from Watertown, through Morris, Litchfield, Goshen and Norfolk. It is stated that the new owners will construct the road next spring. The preliminary surveys have already been made.

SPRINGFIELD, MASS.—It is announced by the officials of the Boston & Albany division that the Newton Lower Falls branch will soon be operated by electricity, the power to be furnished by the Watertown & Newton Electric Lighting Company. This branch is about eleven miles long, and runs from Riverside to Newton Lower Falls. It is understood that about forty trips a day will be made under the new arrangement.

ST. PAUL, MINN.—Proceedings to condemn land for a right of way for a new electric line through southern Minnesota have been brought and about 100 miles of trackage land has been secured. A rural line will be constructed, running through Shakopee, Faribault, Mankato and Albert Lea to the Iowa line. The road will carry passengers, but it is expected that its chief revenue will be from freight or express service.

LAKE PROVIDENCE, LA.—The Lake Providence & Gouldsboro Railway Company, Limited, with a capital of $100,000, has been chartered. The following are the officers and directors: Joseph L. Fischer, president; E. J. Hamley, secretary and treasurer; G. M. Purdy and W. C. Borcherding, directors. The purpose of the company is to build and operate a line of street cars from Lake Providence to Gouldsboro, a suburb of the town.

LEWISTON, ME.—The Lewiston & Kennebec Street Railway has been formed to build twenty-one miles of electric railroad connecting Lewiston, Webster, Wales, Monmouth, Litchfield, West Gardiner and Gardiner, and running into Sabatis. The incorporators are Sidney M. Bird and Maynard S. Bird, of Rockland; George W. Heselton, of Gardiner; John D. Clifford and Charles C. Benson, of Lewiston, and Edward W. Gross, of Auburn. The road will do an express, as well as a passenger, business.

TOLEDO, OHIO—Incorporation papers for the Toledo, Bay Shore & Michigan Railway Company have been sent to Columbus, the incorporators being Frank D. Cope and Frank B. Gunnin, of Pittsburg, and Frank M. Ohl, Willis F. Brown and Joseph R. W. Cooper, of Toledo. The company will construct a road from the terminus of the Toledo Railways and Light Company, at the Casino, to Point Place. The construction of the road will be commenced at once, and completed as soon as possible.

UPPER SANDUSKY, OHIO—The survey for an electric railway between Marion and Tiffin has been completed, and work has been begun on the route from here to Tiffin. The total distance will be about forty miles. It is stated by the projectors that the road has been financed by New York and Philadelphia capitalists, and that the preliminary work will be done this winter, so that construction work can be begun early next spring. When this gap is completed Cincinnati will be connected with Toledo, Sandusky and Cleveland, making a direct line from the lake to the Ohio river.

DETROIT, MICH.—The Grand Rapids & Ionia Railway Company, capitalized at $1,000,000, has been organized here and will build an electric line along private rights of way connecting Grand Rapids and Ionia, Mich., entering Grand Rapids over the tracks of the Grand Rapids Railway. The officers are: president, E. M. Hopkins, of New York and Detroit, president of the Dayton & Kenton Electric Railway; vice-president, John T. Rich, Detroit; treasurer, C. H. Pomeroy, Saginaw; secretary, Frank Westcott, Vernon. The same men propose later to build lines connecting Ionia, Owosso, Lansing and Jackson.

UNIONTOWN, PA.—Surveys are being made to connect Uniontown with Pittsburg, by way of the Monongahela valley, by trolley. The line will run by Vance Mills, Smock, Brownsville, Fayette City and Bellevernon. Several bridges will be required over Redstone creek. The road will run through a populous rural section, and pass several coal and coke works with not less than 50,000 population. Frank M. Fuller, secretary of the Commonwealth; S. M. Graham, of the Fayette Title and Trust Company; Charles H. Seaton and other prominent local capitalists are owners of the franchise rights, and already have the line built from Monessen to Fayette City.

MONTGOMERY, ALA.—A certificate of incorporation has been issued by the secretary of state to several prominent Birmingham people to build a new railroad to be known as the Birmingham & Lineville Railroad. The incorporators are S. E. Thompson, John S. Jemison, W. R. Prowell, R. H. Pearson, Robert Jemison, Vassar L. Allen, of Birmingham, and R. L. Ivey, of Lineville. It is set forth that the present terminal points of the road shall be Lineville and Pyriton, in Clay County. The right is given at some future time to build the road into Birmingham, through the counties of Talladega, Shelby, St. Clair and Jefferson; also to extend the road into Randolph and Tallapoosa counties. The capital stock is $100,000, divided into shares of $1,000 each.

WATERBURY, CT.—It has been announced that the Connecticut Railway and Lighting Company will immediately proceed to construct a trolley line between Waterbury and Cheshire, Ct. A franchise has been secured, the surveys have been completed, and needed rights of way are now being obtained. Construction of the road will put Waterbury in trolley communication with New Haven. Waterbury now has no trolley connection with any other municipality. This property, controlled by the United Gas Improvement Company, of Philadelphia, is a combination of some fourteen street railways, gas and electric light companies. The railways embraced comprise about 160 miles of track. Recent income statements show gross earnings to be $1,615,384, net $679,082, interest charges and taxes $533,735, extraordinary expenses $57,533, and balance, surplus of $87,814.

EAST HARTFORD, CT.—At a special meeting of the stockholders of the East Hartford & Glastonbury Street Railway Company, held recently, it was voted to accept the amendments to the company's charter which were granted at the last session of the General Assembly. The amendments authorize the company to build various extensions in the towns of East Hartford and Glastonbury. The company is a subsidiary corporation of the Hartford Street Railway Company, and the extensions will be constructed by the latter corporation. The Hartford Street Railway Company owns about ninety miles of main track and has enjoyed a prosperous existence for many years, having paid six per cent dividends regularly. Stock and bonds outstanding last July amounted to $1,000,000 and $2,700,000 respectively. Gross earnings have steadily increased from $618,913 in 1899 to $780,558 in 1902, and the surplus from $443 in the former year to $37,213 last year.

PERSONAL MENTION.

MR. THOMAS ELLIOTT, of Pittsburg, Pa., has been appointed chief engineer of the Cincinnati Traction Company, Cincinnati, Ohio.

MR. FRANK M. DUNLAP, M. E., of Detroit, Mich., has been appointed acting assistant professor of mechanical engineering in the University of Michigan.

MR. DAVID MORRISON, of Cleveland, Ohio, has been elected president of the Mansfield & Eastern Electric Railway, to be built between Mansfield and Ashland.

PROFESSOR C. F. CHANDLER, of Columbia University, gave a lecture before the American Philosophical Society recently, his subject being "The Electrochemical Industries of Niagara Falls."

MR. HENRY B. BATES, formerly professor of electrical engineering in the Thomas S. Clarkson School of Technology, at Potsdam, N. Y., has been appointed professor of electrical engineering in the University of Colorado.

MR. CHARLES F. CUTLER, president of the New York and the New York & New Jersey Telephone companies, was elected president of the Hudson River Telephone Company, at a meeting of the directors held on November 19.

MR. R. R. SUTHERLAND, general superintendent of the Chicago, Cincinnati & Louisville Railway, has tendered his resignation to accept the position of superintendent of the Chicago, Rock Island & Pacific Railway, at Topeka, Kan.

MR. J. M. BRYANT, a graduate of Worcester (Mass.) Polytechnic Institute, has been appointed instructor in electrical engineering in the University of Illinois. Mr. Bryant has had two years' experience with the General Electric Company, Schenectady, N. Y.

MR. J. E. POWELL, chief mechanical and electrical engineer, supervising architect's office, Treasury Department, Washington, D. C., recently left New York for Porto Rico, to be absent until January 1, on a tour of inspection of the government buildings of the Antilles.

MR. H. H. VREELAND, president of the Interurban Street Railway Company, New York, and Mr. J. C. Hutchins, president of the Detroit United Railway Company, Detroit, Mich., have been elected honorary members of the Tramways and Light Railway Association, of Great Britain.

DR. CLAYTON H. SHARP has been sent by the Lamp Testing Bureau, New York city, to inspect all of the principal electrical laboratories of Europe. During Dr. Sharp's absence, Dr. C. P. Matthews, of Purdue University, La Fayette, Ind., will advise with the company concerning the photometric equipment of its new laboratory.

MR. JOHN I. BEGGS, president of the Milwaukee Electric Railway and Light Company, has been appointed nominal manager during the World's Fair period of the Union Electric Company, St. Louis, Mo., which has been awarded a contract to supply the World's Fair 10,000 horse-power of electric current, beginning May 1, 1904.

MR. GEORGE H. MOSEMAN, Boston, Mass., has been appointed the first selling representative of the Weston Electrical Instrument Company, of Newark, N. J., for the New England territory. Mr. Moseman was connected with the General Electric Company for ten years, and the old United Edison Company, as well as with the Edison General Electric Company, four years previous to the formation of the General Electric Company.

MR. A. A. THRESHER, of the Thresher Electric Company, Dayton, Ohio, was a New York visitor last week attending to important business connected with his company, as well as taking in the banquet of the Naval Architects and the Horse Show. This company has greatly increased its output since taking over its large factory, and is one of the busiest and most successful electrical manufacturing houses in the Middle States.

DR. BERGEN DAVIS exhibited at the meeting of the Physical Society, recently held at Columbia University, New York city, his apparatus in which mechanical rotation is produced by the electrodeless discharge. The apparatus consists of a little anemometer mounted at the centre of a vacuum tube. The discharge in the tube is produced by an oscillating current in a surrounding coil. The motion of the ions constituting this current then produces rotation in the anemometer.

ELECTRICAL SECURITIES.

Despite the general depression of values which still holds in financial circles, there is a cheerfulness evidenced which is remarkable in its extent and strength. Except in the steel and iron trade, there seems little to encourage the belief that there will be any strong tendency toward a reaction in industrial conditions. There has been so much recently in the speculative field to raise a doubt in the public mind as to the safety of speculation, that it is not remarkable that the public is staying away from the market, even when contingencies which would ordinarily provoke a good rally occur. The daily reports of railroad earnings are satisfactory, and the October report of foreign trade was encouraging. This report gave the second largest total of exports for a month in the country's history.

ELECTRICAL SECURITIES FOR THE WEEK ENDING NOVEMBER 21.

New York:	*Closing.*
Brooklyn Rapid Transit	38¼
Consolidated Gas	177½
General Electric	153
Kings County Electric	160
Manhattan Elevated	138¼
Metropolitan Street Railway	114⅛
New York & New Jersey Telephone	140
Westinghouse Manufacturing Company	165

The annual stockholders' meeting of the Metropolitan Securities Company, the holding company of the Metropolitan Street Railway Company, will be held at 32 Liberty street, New York city, December 9 at 12 M.

Boston:	*Closing.*
American Telephone and Telegraph	125¼
Edison Electric Illuminating	240
Massachusetts Electric	76½
New England Telephone	120
Western Telephone and Telegraph preferred	79

The American Telephone and Telegraph instrument statement for the month ended October 30 is as follows: gross output, 111,749; returned, 49,885, leaving a net output of 61,864, as compared with a net output of 55,446 for October, 1902. Since December 20 last the gross output has been 923,978 and the returned 408,716, leaving a net output of 515,262, as compared with 517,091 for the same period last year. The total number of instruments outstanding October 30 was 3,665,582, against 3,042,697 at the same time last year.

Philadelphia:	*Closing.*
Electric Company of America	7⅜
Electric Storage Battery common	47
Electric Storage Battery preferred	46
Philadelphia Electric	5⅞
Union Traction	43⅞
United Gas Improvement	78½
Chicago:	*Closing.*
Chicago Telephone	122½
Chicago Edison Light	140
Metropolitan Elevated preferred	55
National Carbon common	17½
National Carbon preferred	86⅞
Union Traction common	5½
Union Traction preferred	29

NEW INCORPORATIONS.

IRONTON, OHIO—The Eureka Trolley Company. $30,000.

COLUMBUS, OHIO—The Mantua Light, Heat and Power Company; $10,000; incorporators, Edgar P. Williams, Fred Price, C. M. Williams, William J. Kelly and William O. Comer. The Pataskala & Hebran Telephone Company; $65,000; incorporators, Dwight E. Sapp, Frank L. Beam, Clayton H. Bishop, Robert M. Greer, C. Wesley Coe and Bonner M. Allen.

INDUSTRIAL ITEMS.

THE CROCKER-WHEELER COMPANY, Ampere, N. J., has established headquarters for the southern representative of its Washington office, Mr. S. M. Conant, at 425 Empire Building, Atlanta, Ga.

THE H. E. LINDSEY ELECTRICAL SUPPLY COMPANY, 1007-1011 Locust street, St. Louis, Mo., announces that it has changed the name of the company from the above to the Century Electric Company.

THE ELECTRIC APPLIANCE COMPANY, Chicago, Ill., general sales agent for the Zenith lamp, reports that the large increase in factory output which has recently been effected will obviate any further delay in filling orders for these lamps.

THE NORTHERN ELECTRICAL MANUFACTURING COMPANY, Madison, Wis., is distributing its new motor booklet No. 33. This is devoted to its "B" frames, a new size built to meet the demand for a small sized Northern machine. This booklet will be sent on request.

THE AUTOMATIC ELECTRIC COMPANY, Chicago, Ill., has received an order from Bills Brothers for a complete equipment for an automatic exchange of 2,000 stations (initial installation) for Sioux City, Iowa. The exchange will have an ultimate capacity of 10,000 stations.

THE SAWYER-MAN ELECTRIC COMPANY, New York city, N. Y., has recently issued an attractive booklet descriptive of the incandescent lamps which it manufactures, and also containing interesting suggestions for those who use incandescent lamps. This little book will be sent on request.

THE ELECTRICAL APPLIANCE COMPANY, Cincinnati, Ohio, announces that it is meeting with a very large demand for the Churcher alternating-current rectifier, which it manufactures. This company will be pleased to send illustrated literature describing the design and capacities of this apparatus on request.

THE ELECTRIC CONTRACT COMPANY, 202-204 Centre street, New York city, has issued its new catalogue No. 4. This describes a fine line of electrical novelties, dry batteries and automobile specialties. The company is the general selling agent for Williams spark coils and Jaeger bulbs. This catalogue will be sent to any one upon request.

THE TRUMBULL ELECTRIC MANUFACTURING COMPANY, Plainville, Ct., is the manufacturer of the "Ideal" cord adjuster. This adjuster is easy to install, simple in construction, takes the strain entirely off the lamp, and stays adjusted. The device is entirely separate from the lamp cord. The New York office of the company is at 136 Liberty street.

THE WARNER ELECTRIC COMPANY, Muncie, Ind., manufacturer of electrical specialties, dry batteries, and the sole manufacturer of the Warner pole-changer, announces that on November 2 suit was brought in the United States Court against the Illinois Electric Specialty Company for the alleged infringement of patent No. 685,887, issued November 5, 1901; reissued October 13, 1903; and No. 739,128, issued September 15, 1903, on the Warner pole-changer.

THE CENTRAL ELECTRIC COMPANY, Chicago, Ill., has issued a circular calling attention to its line of electric fixtures. An entire room of its establishment has been fitted up for the purpose of displaying fixtures, and while the display itself is not large, the decorations are pleasing and of an exceedingly attractive nature. The fixtures shown are varied, including almost everything of an electrical or combination nature, as well as glassware and trimmings. This display is a convincing argument that the company is an important factor in the fixture business, and is prepared to take care of a large and growing business.

MR. GEORGE H. MOSEMAN announces that he has been appointed selling agent for the Weston Electrical Instrument Company, of Newark, N. J. He will be established at 176 Federal street, Boston, Mass. In establishing a selling agent in Boston, the company has responded to a demand for more direct connection with the large number of electrical engineers, electric light and power stations, educational institutions and others located throughout New England who are interested in electrical measuring instruments, and appreciate the high grade of instruments for station, laboratory and testing work which this company has developed.

THE LAMP TESTING BUREAU is equipping its electrical testing laboratory, Eightieth street and East End avenue, New York, with the most complete and up-to-date apparatus a wise and liberal management can procure. Nothing better indicates the broad policy of the company than the fact that it has recently sent its test officer, Dr. Clayton H. Sharp, to inspect all of the principal elecrical laboratories of Europe, so that, on his return, he may be better able to equip the new laboratory to meet the needs of those who require its services. During Dr. Sharp's absence, the company has secured the services of Lr. C. P. Matthews, of Purdue University, La Fayette, Ind., to advise concerning the photometric equipment of the new laboratory.

MR. G. M. GEST, the well-known subway conduit contractor, New York and Cincinnati, has been awarded the contract for the installation of a complete conduit system by the Manchester Electric Company, Manchester, Mass. Manchester is an ideal resident place for many of the prominent people of New England, and boasts of many fine private residences, and is modern in every way. This conduit system being installed requires in all a quarter of a million feet of conduit, and covers fifteen miles of streets. A system of this extent for a country residential place is rather unique. The increasing use of high-tension alternating currents, and the facility and modest expense with which conduit can now be laid, are making this form of underground engineering very popular.

THE BULLOCK ELECTRIC MANUFACTURING COMPANY, Cincinnati, Ohio, is distributing a bulletin describing the Bullock type "B" motors and generators. This type has been designed to meet the increasing demand for small machines which will successfully withstand rough usage. The machines are thoroughly well built mechanically and electrically, and each machine is carefully tested before leaving the factory. They are guaranteed against mechanical and electrical defects for a period of one year. The generator rating for moderate-speed, open-type, compound-wound machines is 120 volts from six to twenty-five kilowatts. The motor rating for slow-speed machines is 120, 240 and 500 volts from one and one-quarter to twenty-five horse-power for open machines, and one to twenty horse-power for enclosed ones. The moderate-speed machines are from two and one-half to thirty-five horse-power for the open machines, and from two horse-power to twenty-five horse-power for the enclosed.

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia, Pa., has recently closed a contract with the Indiana Interurban Construction Company for the installation of a battery of chloride accumulators for the Kokomo, Marion & Western Traction Company, at Kokomo, Ind. This battery consists of 288 cells, having a capacity of 384 kilowatts, and is to be used in regulating the load on sixty-cycle rotaries, so that the lighting and railroad service can be obtained from the same generators. A contract has also been closed with the Department of Commerce and Labor, Washington, D. C., for two batteries, to be operated by the National Bureau of Standards, Wasnington; with the Clark University, Worcester, Mass., and the Bacon Air Lift Company, for the residence of Herman B. Duryea, Westbury, L. I.—This latter installation consists of a battery of sixty-eight cells, having a capacity of forty-six kilowatts, to be used for lighting and power after the generator plant has shut down for the night.

THE KINSMAN ELECTRIC AND RAILWAY SUPPLY COMPANY, 91 Liberty street, New York city, is booming the new Kinsman "Daylight" desk lamp, This electric desk lamp is constructed on scientific principles, and is of great value to those who are compelled to do desk work. The parabola effect creates a light which is soft and abundant and well distributed, leaving no shadows or dark corners on the desk. At the same time, the lamp is entirely shaded from the eyes. In appeartnce it is ornamental and attractive, is adjustable in six directions, and in no way interferes with the opening and closing of a roll-top desk. Another specialty which this company is calling attention to is the Kinsman automobile cable. This cable is extremely flexible. It is made up with a core of high-tension conductor, surrounded by a sheathing of pure rubber. This, in turn, is surrounded by a covering of white core rubber, which is wrapped in a high-resistance vulcanized rubber, the whole being taped with an insulating braid. The braid and tape are protection from oil, and, with a lead covering, this cable is absolutely oil-proof. Circulars describing these and other specialties manufactured by the Kinsman company will be sent upon request.